ONTARIO PUBLIC SCHOOL
HEALTH BOOK

AUTHORIZED BY THE MINISTER OF EDUCATION

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ONTARIO PUBLIC SCHOOL
HEALTH BOOK

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PREFACE

The general opinion obtained in answer to a questionnaire sent to the inspectors and to a large number of the teachers of the Province was that a suitable book in hygiene should be interesting to the pupils, free from technical terms, and contain only such physiology as is necessary; and that its aim should be to arouse a desire for proper living, to develop health habits, and to teach the pupils of our public schools some simple means for the prevention of disease.

These opinions have been kept constantly in mind; and it will be found that higher standards of personal hygiene and the latest means for the prevention of disease have been pressed upon the attention of the pupils throughout the book. Included in the book, also, are certain tables of height and weight, and diet tables, which it is hoped will help to make it more complete and more useful.

The whole work has been written in a simple, lively style which will be interesting to young readers. Short stories have been introduced here and there, and information of a scientific nature has been presented in a way intended to arouse the interest of the pupils and to induce them to read the book in order to solve the mysteries suggested to them.

To crystallize the ideas presented in this book into habits of daily life, is the work of the teacher, who will easily find many methods of making practical its teaching.

Toronto, September, 1925.

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INTRODUCTION

More than eight hundred years ago, when William the Conqueror was king of England, his eldest son Robert, Duke of Normandy, set out as a soldier in the First Crusade to the Holy Land. At the siege of Jerusalem he was wounded in the arm by a poisoned arrow. Finding that the wound did not heal, he went for treatment to Salerno, a city of Italy famous as a health resort and as the home of the most skilful physicians in Europe. Here Robert was treated, and soon his wound was completely healed.

Before he departed, the physicians of the College wrote a book for him, to tell him how to keep himself well and strong. This was called *The Regimen of Health*. As at that time printing had not been invented, this book was written by hand. But in later years it was printed and reprinted many times, becoming the most famous book on health in those early centuries. For hundreds of years it continued to be read, because it contained some very quaint sayings as well as much useful advice.

Robert was fond of hunting and sports. Probably he worried very little about his health or about sickness or disease. When well it is perhaps natural that one should give little thought to one's health. Nevertheless there are many simple things regarding the care of the body which every one ought to know. The physicians of Salerno evidently thought so, too; or they would never have taken the trouble to write that famous book.

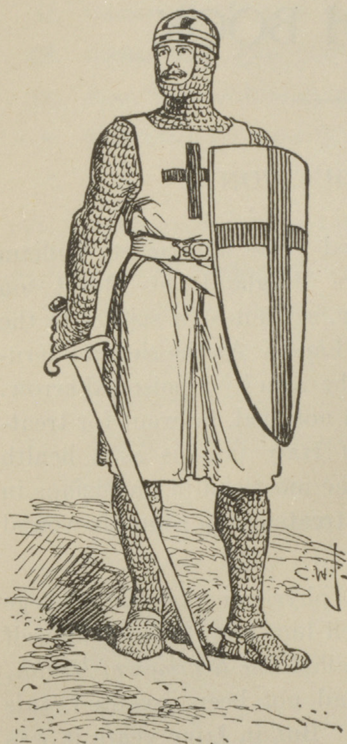

Fig. 1.—A Crusader.

Among other things, they told Robert that he should avoid worry, advising him in their quaint way—"from Care his head to keepe." They cautioned him against excesses at the table, both in eating and in drinking. They advised him to take plenty of outdoor exercise and sufficient rest. They pointed out the value of bathing, of cleanliness, and of the proper elimination of the body's waste products. Their advice regarding the treatment of disease, however, was naturally very crude and was tinged with the superstition of the times.

Their knowledge regarding the prevention of disease amounted to little, for at that time practically nothing was known about its causes.

Since the Crusades, the discoveries of scientists and physicians in different parts of the world have taught us a great many things about the human body and the causes of disease. The structure of the body and the action of its various parts are more fully understood, so that we now know better how to take care of it and how to keep in good health. We have learned, besides, that many diseases are preventable, and the means for their prevention are understood.

Just as the doctors of Salerno so long ago thought that they might help Robert, Duke of Normandy, to keep healthy by means of the rules found in *The Regimen of Health*, so this book has been written for the boys and girls of our schools to-day, to help them to be strong and healthy.

Much is known now about the human body and how to prevent disease, and every one to-day realizes the importance of good health. Accordingly, it is hoped that the information found in these pages may help boys and girls to form proper habits so necessary for the maintenance of good health, and that it may explain how certain diseases are caused and may be prevented.

I. HEALTH HABITS

CHAPTER I

FOOD

THE great incentive to work is the need of food. Without it neither man nor nation can live. The bounty of nature has supplied us with an infinite variety of foods in the animal, the vegetable, and the mineral kingdom; but to secure this food man must work. In some countries less work is required than in others; but everywhere man must sow, and cultivate, and reap, or he must hunt and fish to gather what he needs.

The easy-going Southern negro lad prefers a piece of watermelon to the piece of blubber which satisfies the Eskimo lad of the far north. This preference is due partly to a difference in climate and partly to the different kinds of food available.

We, in Canada are fortunate in having food in great variety and abundance. We have grains, and vegetables, and fruits, as well as meats, fish, and game of many kinds, sufficient to satisfy all tastes and requirements. But Canadians were not always so fortunate. The early settlers, owing to the scarcity of food and the difficulties of transportation, suffered many privations, especially during the winter.

But modern civilization enables us to obtain all the varieties of food we require for maintaining good health in every season of the year. Through our wonderful railway and shipping facilities we are able, in one part of Canada, to obtain foods which have been grown in

another. We are able to store quantities of grain for long periods of time in great grain elevators; our supplies of meat may be kept in cold storage plants; and improved methods of canning and preserving make it possible for us to have fruits and vegetables in winter as well as in summer. Thus the farmer, the miller, the dairyman, the butcher, the storekeeper, and the errand boy are all working together to provide us with wholesome and appetizing food at all times and seasons.

A variety of foods is not merely a matter of luxury; it is really essential. Over three hundred years ago, during the voyages of Cartier and the explorations of Champlain, a very serious disease called scurvy broke out among the men, because of a lack of proper food. Those who were affected by it became very weak, their limbs swelled, and sores broke out all over their bodies, their gums became inflamed, and the teeth became loose and often fell out. In an account of Cartier's voyages there is a vivid description of the ravages of scurvy among his men while wintering at St. Croix. "Out of one hundred and ten souls that we had been, not ten were free from it. Our condition was pitiable, considering the place where we were; for the savages came every day, and we were in great fear lest they should perceive our distress and defenceless condition; and to conceal it from them, our Captain, whom God had preserved, had noises made on board the ships with sticks and stones, as if work were being done."

We know now that scurvy broke out because the food, which consisted largely of salt meat, lacked something which is absolutely necessary to health. When spring came round, and green vegetables and fruits were added to the diet, this terrible disease disappeared.

To-day there is little danger from lack of the right kind of food, but there is some danger in the over-refinement of food. Instead of using coarse brown bread which contains the husks of the grain, we usually eat fine white bread from which the husks of the grain have been removed by milling. This refinement of food, if it is carried too far, is a mistake.

A few years ago many people in Japan, where rice is much used for food, were suffering from a painful disease called beri-beri. On investigation it was found that the victims of the disease were those whose diet was mainly polished rice, that is, rice from which the husks had been removed. Those who ate ordinary whole rice escaped. There is something in the husks of the rice which protects the Japanese from beri-beri, just as there is something in fresh vegetables which would have protected the early explorers from scurvy.

To the invisible but important elements of food which protect us from these diseases and greatly influence our growth and development, we give the name vitamins. Vitamins are found in many fruits, such as oranges and apples; in leafy vegetables, such as lettuce, spinach, and cabbages; and in tomatoes and cauliflowers. They are also found in dairy products, such as milk, cream, butter, and cheese. Foods containing vitamins are absolutely essential to health and should form a large part of everybody's diet.

Coarse, bulky food is also very necessary for perfect digestion. The muscles of the stomach and intestines, which constantly contract and relax, must have something to work upon.

A certain explorer in Africa, who had carefully calculated the amount of food that he should carry with him, failed to take into account the matter of bulk. He soon found that the natives of his party were not satisfied with the meals he provided for them. When he discovered what was wrong, he chopped up some coarse grass and mixed it with their rations. This addition, which gave the food the required bulk, quite satisfied the natives, and they continued their journey without further objection. Of course we should not like to eat grass; but we can obtain the same result in a far better way by eating such vegetables as cabbages, lettuce, cauliflowers, spinach, carrots, beets, peas, and beans.

Too much soft and easily digested food leaves but little for the teeth, the jaws, or the digestive organs to work upon; and as a result they lose their strength and vigour, just as any other part of the body becomes weak without proper exercise.

Our bodies are constantly subject to wear and tear, and the loss must be replaced by the food we eat. We must also eat in order to keep up the heat of the body and to supply its energy, much in the same way as coal and wood produce heat and energy when burned under the boiler of a steam-engine. Children need food, also, for their growth. A deficient diet retards the normal growth, as may be seen in many under-nourished children.

One must bear in mind, however, that height and growth depend not only upon one's diet but also upon the size of one's parents. Children of small parents are generally smaller than those of larger parents. Some boys and girls would never become very large men or

women no matter how much they ate, any more than a canary would become as large as a crow simply by trying to eat as much as the crow. Proper food, however, is very important for growth.

While the vitamins are necessary, the main constituents of our food are proteins, carbohydrates, fats, minerals, and water.

Proteins build up the body and repair the cells which make up the tissues of the body. Eggs, meat, milk, nuts, peas, and beans are all rich in protein.

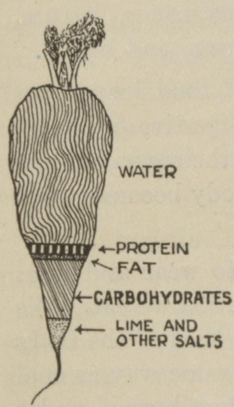

FIG. 2.—The food contents of a carrot.

Carbohydrates help to produce the heat and energy of our bodies. Cereals such as wheat, corn, and oats, from which our bread, porridge, and cakes are made, potatoes, and also sugar, supply most of our carbohydrates.

Fats help to supply the body heat, and some fats are stored up in our bodies as a reserve food supply. These are obtained not only from meat but from rich milk, cream, butter, and from certain nuts and seeds.

Minerals such as ordinary table salt and lime are also necessary for our nutrition. Calcium, or lime, which is found in milk, builds up the bony framework of the body and the teeth. Iodine is also required, and this is found in various products of the sea such as fish and seaweed. Many vegetables also contain mineral salts which are healthful.

Water is not commonly thought of as essential to our diet, but it is really of the first importance. We might possibly live for days without food, but we cannot live long without water. Water forms over sixty-six per cent or about two-thirds of the human body. Nearly all foods contain a high percentage of water.

An apple contains about eighty-five per cent of water, a potato seventy-eight, a carrot eighty-six, and a parsnip eighty per cent. Even our bread contains about thirty-one per cent, and milk eighty-seven per cent of water.

The human system requires a great deal of water to replace the loss through perspiration which is going on all the time, and also to replace the water which leaves the body through the breath. We may see that this is so by breathing upon a mirror. The exhaled breath causes a little fog on the surface, and tiny droplets of water are visible. Water is essential to replace all this loss and to supply the various parts of the body with fluid for their work. These then are some of the reasons why we should drink plenty of water. Three or four glasses of pure water or even more taken every day are good for one.

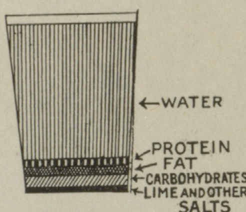

Fig. 3.—Food constituents of a glass of milk.

It is necessary for growing boys and girls to have a "well balanced" diet containing all of these constituents —proteins, carbohydrates, fats, vitamins, minerals, and water.

Young babies, of course, live on milk alone, and they thrive on this because it contains all of these constituents. As one grows up, milk alone is not

enough. It fails to satisfy all the requirements of the body. It is, however, a most useful addition to everybody's diet and is especially good for children. Every boy and girl should drink at least three glasses of milk every day. This, with the milk used on their porridge or cereal, will make about a quart a day.

Fig. 4.—School children taking their drink of milk.

A trial was once made with a certain group of children. At first they were all weighed. Milk was then added to the regular meals of half of them and was left out of the meals of the others. In a few weeks' time all the children were weighed again, and it was found that those who had taken the milk had gained several pounds more than those who had gone without it.

Many schools now recognize the importance of children getting sufficient milk to drink, and in some places milk is supplied regularly to classes in the schools.

Tea and coffee have no food value, and are, therefore, omitted from the list of foods that are essential. They are used as beverages by adults, but should not be taken by children. Milk is better than tea or coffee for children, and, as has been said before, water is absolutely essential.

How much food should we eat? Our needs vary according to our age, size, activity, and personal peculiarities. Even the climate and the seasons of the year make a difference in the quantity of food we require.

A scientist would say that a person needs a certain number of calories every day in his diet. A certain amount of heat and energy may be obtained from a given amount of food, just as a certain amount of heat and energy may be obtained from a scuttle of coal. A unit of this heat and energy supplied by food is called a calorie.

An adult weighing 156 pounds needs food containing about 2500 calories every day. If the same man is working very hard, he may need 3500 calories or more. As boys and girls require a certain number of calories for their growth as well as for the production of energy and heat, they will need about as much food as their parents.

Of course the younger the children the less they will need. Naturally a big boy will need more to eat than a little one. A girl who has been skating or walking

will eat more than her sister who has been resting quietly at home all afternoon. Most people desire more to eat on a cold winter day than they do on a warm summer day, the reason being that on a cold day more food is required for keeping up the heat of the body than is required on a warm day.

While the study of calories is very necessary for those looking after the diet of large numbers of people, such as soldiers, sailors, and patients in hospitals, yet the average person need not worry about these things. The appetite, if not dulled by unsuitable food, artificial stimulants, and irregular meals, is a fairly safe guide as to the amount of food required.

The following diet for one day should be sufficient in quantity; and it is well balanced, for it contains all the essentials just mentioned; viz. proteins, fats, carbohydrates, minerals, vitamins, and water.

For breakfast an apple or an orange or stewed fruit, a plate of porridge or cereal, some bread and butter or toast, and a glass of milk should be sufficient. A soft-boiled egg or a small piece of bacon added to this would not be too much for a healthy boy or girl. A good breakfast is a big help towards a full day's work and play.

A substantial dinner will consist of an egg or a piece of meat or chicken or fish, with vegetables, bread and butter, plain pudding or fruit, and a glass of milk.

For supper a cereal, some stewed fruit, bread and butter, a piece of plain cake, and a glass of milk should suffice.

CHAPTER II

APPETITE

"Use three physicians still; first, Dr. *Quiet;*
next, Dr. *Merryman;* and Dr. *Dyet.*"
—*The Regimen of Health.*

SOME people are surprised that children have such hearty appetites and eat so much food. Children are smaller than their parents, and yet they seem to eat more. The reason for this is that they need food for their growth as well as for their nutrition; while their parents, who have already reached their full growth, do not need any additional food for that purpose.

It is fortunate that most boys and girls are blessed with a good appetite. There are some, however, who pick and fuss over their food, who do not like this and will not eat that; thus causing worry to their parents who have done their best to provide good wholesome food. Often these children eat between meals, and for that reason do not care for anything when the regular meal is served, because their appetite is gone. If they would give up this practice, they would eat their regular meals with much greater enjoyment.

"Hunger makes the best sauce," runs an old saying, and Æsop illustrates this truth in this fable:

"An ass was loaded with provisions of many kinds, which he was carrying home for a great feast. On the wayside he met a fine large thistle, and being very hungry he ate it. As he munched he thought to himself: How many greedy epicures would think themselves happy amidst such a variety of delicate viands as I now carry! But to me this bitter prickly thistle is more

savoury and relishing than the most exquisite and sumptuous banquet.

"It is not in the power of the whole art of cooking to give such an exquisite relish and seasoning to a dish, as temperance and exercise will confer on the plainest fare."

Plenty of outdoor exercise and fresh air make the appetite keener, because both of these help to keep one healthy, and appetite depends largely upon the health of the body. Rest is also important. Though exercise is very beneficial many children need more rest than

Fig. 5.—A well laid table.

they get. Delicate children sometimes play so hard and so long that they become overtired and do not care for their food. Even healthy children may lose their appetites by becoming overtired. Probably at some time you have been on a long tramp, and on the way home in the late afternoon have found yourself thinking of supper and talking about the things you like best to eat.

But before you have reached home you have become so very tired and weary that your appetite has gone. After a good rest, however, it revived, and you were ready to eat whatever was placed before you.

A tired brain takes away one's appetite in much the same way as does a tired body. After a hard day's study in school you may not care to eat your supper immediately. A brisk walk in the open air or some work or play that does not require much mental exercise will usually restore your appetite.

Regularity in meals is a most important help in keeping the appetite good and the body healthy. Cheerfulness, or as the old *Regimen of Health* says, "Doctor Merryman," at meal-times is a far better appetizer than catsups or spices. "Laugh and grow fat" is an old saying, and it is true that talking about pleasant things and enjoying a good laugh are the best accompaniments of a meal. Work and worry should never be taken to the table.

Cleanliness in the preparation of food, and careful cooking, improve the appetite, and a well laid table with its appetizing food, clean linen, and bright surroundings often makes the mouth water. When the mouth waters, it means that the juices of the mouth are ready for their part in the work of digestion.

One must be on guard against unhealthy appetites, that is, the desire for food such as candy, cakes, and pastry between meals, just because their taste is pleasant and not because the body really needs them for growth and development. Cakes and candy should be eaten only after a meal. Sometimes, too, the appetite must be controlled in order not to overeat, and it should even be trained to like foods which will make our bodies strong.

CHAPTER III

CARE OF THE TEETH

From the time the baby cuts his first teeth to the time when, as a grandfather, he begins to lose them, his pleasure and happiness depend very much upon the condition of his teeth. Sound teeth promote health and comfort. Diseased teeth are the cause of much illness and pain. We must always remember that teeth are not just hard white pegs attached to the jaw, to be used carelessly for any kind of work or to be abused in cracking nuts and opening pen-knives. They have a special work to do for which they are carefully formed. If we look at our teeth in a mirror, we shall notice that some of them are sharp and some are blunt. They are curiously constructed, and so wonderfully arranged in the way they come together in biting that they make a splendid milling-machine for cutting and grinding food, and thus properly preparing it for digestion.

During our lifetime we have two sets of teeth—the primary, and the secondary or permanent teeth.

The primary set, sometimes called the first or milk teeth, are twenty in number. The baby usually cuts his first tooth when he is between six and nine months old. The primary teeth should all be in place by the time he is two or two and a half years of age. It is important that these teeth should be carefully preserved until the permanent ones, which have been meanwhile forming deep down in the jaws, are ready to take their place. If the first set are allowed to decay and are lost too soon, the jaws do not grow and develop sufficiently to make room for the larger permanent teeth.

When the child is seven years of age, the temporary teeth begin to loosen and drop out, being gradually pushed out of place by the permanent teeth, until, at the age of twelve or fourteen, they have all been replaced. The last of the permanent molars do not come in until early adult life, and on that account they are often called wisdom teeth.

The permanent teeth are thirty-two in number. The first one to make its appearance is the first molar or double tooth, which, appearing when the child is six years of age, is commonly called the six-year molar. It is a most important tooth, because it comes in behind the temporary teeth, and its location determines the position of all the other permanent teeth. It has been truly called the keystone of the arch. If the temporary teeth are lost too soon, and the keystone tooth, as a result, comes in too far forward, or if this important molar is itself lost through decay, it is almost impossible to have the regular teeth that add so much to one's appearance.

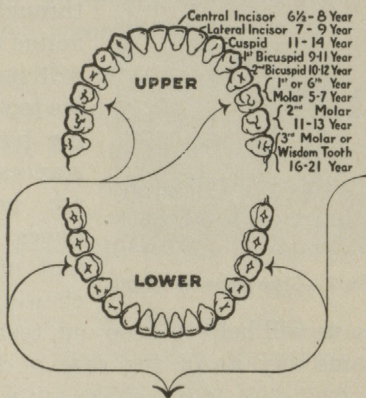

FIG. 6.—Parents many times want this tooth extracted not realizing that it is the KEYSTONE OF THE DENTAL ARCH and its loss is the cause of irregular or crooked teeth.

Beautiful arches of clean sound teeth are among the greatest gifts that nature can bestow upon us; but we must remember that nature gives us this gift to keep only on the condition that we take care of it.

Our teeth are intended to be used. To keep them healthy we must give them exercise, and the best exercise for them is the chewing of solid foods such as meats and fruits and crusts.

The exercise from chewing solid food is of benefit in many ways. It not only keeps the teeth sound, but it also massages the gums and keeps them pink, firm, and healthy; and the exercise of the jaw muscles helps to develop a properly shaped face. If we eat soft foods only, the teeth will decay and the gums will become unhealthy through want of exercise. Examine a dog's mouth and you will notice how clean and white his teeth are; he has been chewing bones and other hard substances. Our teeth, of course, are not formed for grinding bones, as are the teeth of dogs and other animals. But the chewing of food that is suited to us will help to keep our teeth clean and sound in the same way as in the case of dogs and other animals.

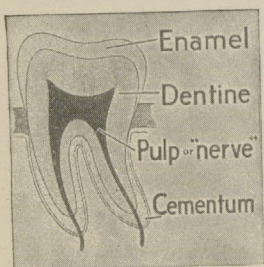

Fig. 7.—Cross section of a tooth.

The part of the tooth which we can see is called the crown, and it is covered with a pearly white enamel which is the hardest substance in the body.

This enamel should be carefully protected from injury, and one should not use one's teeth on things which might crack it. Breaking hard nuts, biting off threads, and the too vigorous brushing of the teeth with a hard brush all injure the enamel.

The other part of the tooth—the root—fits into a socket in the jaw-bone. Most of the tooth is made up

of a bony substance called dentine, but in the centre of it is a pulp containing the blood-vessels and nerves which give the tooth nourishment, life and feeling. Sometimes we wonder why teeth need to have these nerves which we know hurt us so much when we have toothache. But we should think of the nerves as good watch-dogs which warn us of the presence of danger. When a tooth is aching, it means that it is in danger of its life, and that we should have a dentist attend to it in order to save it. If there were no nerves in the teeth, we might never know of their decay until they had quite crumbled away and become useless.

Chewing gum, even though it gives exercise to the jaws, is a harmful habit. Some people say that it cleans the teeth, but it fails to clean the spaces between them and the places close under the gums where cleaning is most needed. It merely rubs the surfaces over and over again, and this the lips and the tongue do just as well. As an aid to digestion its action is also deceiving, as gum chewing stimulates the flow of saliva all to no purpose, for there is neither starch in the mouth for it to digest nor food to swallow. The continual flow is unnecessary, and the constant exercise of the glands which produce saliva is harmful.

To preserve the teeth three rules must be followed:

1. Eat the right kind of food
2. Keep the mouth clean.
3. Visit the dentist regularly.

1. Proper food is the most important factor in developing sound teeth and in keeping them healthy. The

teeth, like the bones, are composed for the most part of calcium or lime salts—elements which are derived from certain foods such as milk, fresh fruits, vegetables, and whole wheat bread. If a large proportion of our daily diet is made up of such foods, the teeth will be properly built up or calcified. But if instead we eat too much white bread, cakes and pastry, or too much sugar and candy, the teeth will not get sufficient lime salts or sufficient exercise in chewing to keep them strong and healthy.

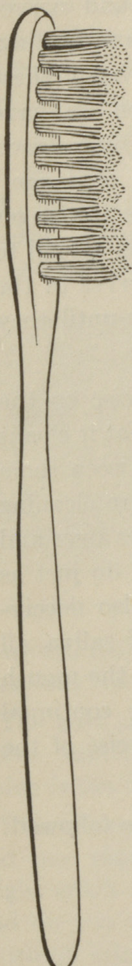

Fig. 8.—Toothbrush.

Decay of the teeth is largely caused by an acid formed from decomposing food left between and around the teeth. This acid is formed chiefly from sweet things such as sugar, candy, cakes, and white bread—all of them soft foods which naturally tend to stick to the teeth. The enamel or protecting surface of the tooth is dissolved by the acid, and a cavity is formed. From this it may be seen that the first means of preventing decay of the teeth is not only to avoid an excess of soft, sweet, or starchy foods, but to take plenty of the food, especially milk, which will supply lime salts, as well as those foods which require vigorous chewing.

2. The second means of preserving the teeth is to keep them clean by brushing, so as to remove all soft, clinging particles

of food after eating. Each person should have a toothbrush of his own and should use it regularly.

HOW TO BRUSH THE TEETH

The teeth should be brushed *at least* twice a day—the first thing in the morning and the last thing at night. A brush of medium size should be used.

Fig. 9.—Brushing his teeth.

Hold the brush firmly, placing the bristles well up on the gums, and with a rotating wrist motion sweep the brush over the gums and teeth in such a way that the bristles will pass between the teeth just as a broom sweeps out the cracks of a floor. Always brush the

gums towards the edge of the teeth on both outer and inner surfaces, that is with a downward motion on the upper teeth and an upward motion on the lower teeth. The grinding surface of the teeth may be brushed vigorously in all directions. Camphorated chalk is an excellent tooth-powder.

After the teeth are thoroughly brushed, take a mouthful of lukewarm water, close the lips, and by puffing the cheeks in and out, force the water between and around the teeth. Be sure always to do this after brushing. After using the toothbrush, wash it thoroughly, shake it out, and hang it up in a clean place by itself.

3. The final means of preserving the teeth and of making sure that no decay is setting in is to visit the dentist at least once a year. You should not wait until toothache has given a warning. If the dentist is visited in time, he will examine your teeth, and if he finds a small cavity, will fill it before it is large enough to be painful. Besides this he will be able to give the teeth a thorough cleaning, removing any stain or tartar that may have been deposited at the gum margin.

Time and money spent on proper care of the teeth will be fully repaid, for a sound set of teeth means better health, better work, and more enjoyment.

CHAPTER IV

DIGESTION

THE Process Building at the Canadian National Exhibition is one of the most popular places with the boys and girls. Here such things as shoes, brooms, and breakfast foods are seen in the process of manufacture. Still more interesting are the great manufacturing plants scattered over different parts of Canada, where raw materials are converted into the finished article. In some places we may see cloth manufactured from wool, in others paper manufactured from pulp wood, in others again steel rails made from pig-iron. Complex and wonderful as these processes are, they are not as marvellous as the processes occurring in nature.

No one has ever invented any process so mysterious as the conversion of a little seed into a huge watermelon. Nature alone holds the secret. After the seed is placed in the ground, if it obtains sufficient moisture and warmth, it soon bursts its shell, and a tiny root appears. This reaches out for moisture and grows into the ground. Then a shoot appears, and this grows upwards in search of light and air, until there blossoms a flower which in time grows into a big watermelon. For its growth the plant needs sunlight, heat, moisture, and food. The food is obtained from the substances found in the air and in the water of the soil. In its own mysterious process building it converts these simple raw materials into the luscious watermelon.

In like manner the growth and nutrition of our bodies is a process by which our food is converted into

bone, muscle, nerve, brain, and other parts of the body, so that the little eight-pound baby grows up and becomes an eighty-pound boy or girl.

This wonderful change depends upon digestion—a process for which special machinery is necessary. For making butter only a churn is needed; for making paper from pulp much more complicated machinery is required; but for the changing of food into human bone, muscle, and nerve, the machinery is so complicated and wonderful that it has taken centuries of study for man to understand even a part of it.

First of all, the teeth assist in this change by cutting up and grinding the food into small pieces. Then the fluids poured out in the mouth act upon these, changing some of the starch into sugar before the food is swallowed. The more slowly we eat our food, therefore, and the more thoroughly we chew it, the more completely is this change brought about.

After being ground by the teeth, the food passes into the stomach—one of the important parts of the wonderful human machine. It is a muscular bag lined with thousands of tiny cells like little wells, too small to be seen except with a powerful microscope. These cells pour out a fluid which has the power of changing the food in various ways, thus preparing it for the final conversion into the elements or parts that go to make up our body. In the stomach the food is thoroughly churned and mixed, to enable the juices from the tiny cells to reach the food particles more completely.

From the stomach the food, which has become more or less fluid, gradually passes onward in its long journey

through about thirty feet of tubing called the intestine. This tube is well supplied with muscles some of which run around it and others lengthwise. These muscles contract and relax, acting just as the fingers do when you close and open your hand. By this motion they mix the food and pass it onward.

The lining of the intestine, like that of the stomach, possesses countless numbers of little cells. Some of these pour out digestive juices which reduce the digestible part of the food to a fluid which other cells absorb. Millions of little blood channels lying next these cells in turn take up the fluid, and through them it flows into large channels. Eventually this fluid is carried by the circulation of the blood as nourishment to all parts of the body.

It may be seen from this description how complicated is the process of digestion, and how necessary it is that each of the various parts of the body should do its share of the work well. If one part is weak or inefficient, all will suffer.

Any of us who have ever had toothache will remember how miserable we felt. We could neither eat, nor sleep, nor play; and although the trouble was in a little cavity no larger than the head of a pin, yet the whole body suffered.

In like manner, if the stomach is abused and the digestion upset, the whole body will suffer.

There is another old fable told by Æsop illustrating this:

"In former days it happened that the members of the human body, taking some offence at the conduct of

the Stomach, resolved no longer to grant it the usual supplies. The Tongue, first, in a seditious speech, aggravated their grievances; and after highly extolling the activity and diligence of the Hands and Feet, set forth how hard and unreasonable it was that the fruits of their labour should be squandered away upon the insatiable cravings of the Stomach. In short, it was resolved for the future to strike off his allowance, and let him shift for himself as well as he could. The Hands protested that they would not lift a finger to keep him from starving; and the teeth refused to chew a single morsel more for his use.

"In this distress the Stomach remonstrated with them in vain. This unnatural resolution was kept as long as anything of that kind can be kept, which was until each of the rebel members pined away to skin and bone and could hold out no longer. Then they found that there was no doing without the Stomach, and, that idle and insatiable as it seemed, it contributed as much to the welfare of all the other parts, as they in their several stations did towards its maintenance."

Since the stomach is such an important member of the human body, it is wise to keep on the best of terms with it, and to have a fair regard for its needs. Having finished a meal, one should not rush off immediately to work, to study, or to play. For proper digestion an extra supply of blood is needed by the stomach, and play or hard work lessens that supply. After meals it is well to rest a while. Digestion is also assisted, by a few moments' rest *before* meals.

The stomach itself needs rest and should not be burdened with food between meals. An apple or other

ripe fruit taken between meals may do no harm, since fruit consists almost entirely of water; but solid food should not be taken. Moreover, the stomach works best at regular intervals; and since it takes about five hours to digest an ordinary meal, our meal times should come at intervals of about that time. Regularity of meals is of the greatest importance if the stomach is to remain a good friend.

A pain in the stomach is often due to eating the wrong kind of food or too much of the right kind of food. In either case the pain is a signal to stop the one or eat less of the other. If the pain does not then disappear, it is possibly due to something else. At any rate one should tell his parents about it, and if necessary the family doctor should be asked to give his advice.

ELIMINATION, OR THE DISPOSAL OF WASTE PRODUCTS OF THE BODY

The waste products of the cells of the body, after passing into the circulation, as described in the next Chapter, are got rid of or eliminated by the kidneys and the bladder.

The fibrous part of the food is not taken into the circulation, but passes down into the lower intestine or bowel. Here it remains for a few hours with some of the body secretions and waste products, until they are eliminated in the natural way. It is *very important* that one should form proper habits, attending to this elimination at a regular time every day, so as to avoid constipation. Otherwise poisons accumulate in the bowels and seriously affect the health.

CHAPTER V

THE CIRCULATION

By digestion is meant the changing of food into nourishment for the body. The body is composed of countless numbers of tiny cells, each with its own work to carry on for the benefit of the body as a whole. Each cell of the body must be supplied with nourishment to keep it alive, and must have a means of getting rid of its waste, or worn-out material. Therefore, some system of transportation is required to accomplish this. This means of transportation the body has in the circulation of the blood.

To understand how it acts, it is necessary for us to know a little about the various parts of which this circulation system is composed.

It consists of a wonderful system of channels for carrying blood and an automatic pump to drive the blood through them properly. The channels or blood-vessels consist of an elaborate network of elastic tubes called arteries and veins, reaching to all parts of the body. These blood-vessels vary in size from some which are as big as one's little finger to very minute and invisible ones. Tiny vessels forming a mesh join the arteries and the veins together.

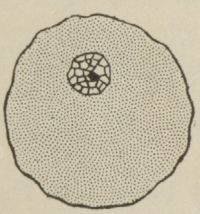

Fig. 10.—A cell greatly magnified. The nucleus is near the centre.

The heart is really an automatic pump about the size of one's fist. It is something like a hollow bag, its walls being made up of very thick and very strong muscles. When these muscles shorten, or contract, as this action is called, the heart becomes smaller,

and forces out the blood contained in the hollow centre somewhat in the same way as if one were to fill a rubber ball with water and drive this water out by squeezing the ball.

It is difficult to imagine what a wonderful pump this is. Let us consider the work it has to do. The total amount of blood in the body of a boy or of a girl is about one-sixteenth the weight of the body. All this

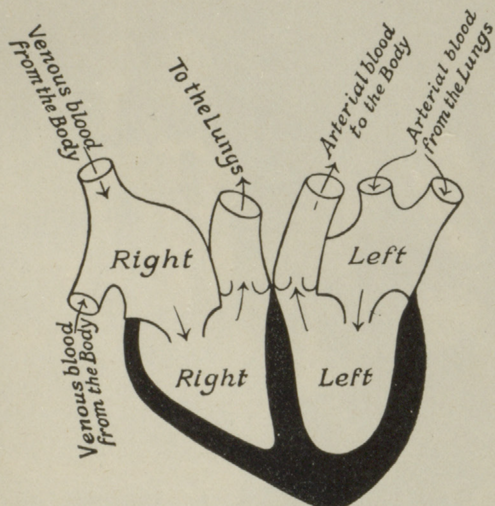

FIG. 11.—Diagram of heart showing direction in which the blood flows through its four chambers.

blood is sent around the body in about one and one-quarter minutes. The amount of work done in twenty-four hours by the heart of a person living under usual conditions is enough to lift that person to about twice the height of the highest skyscraper in the world. This work is done, day in and day out, without our being conscious of it.

A thin wall divides the hollow portion of the heart into two halves, so that when the heart contracts the blood in one half goes to the lungs and the blood in the other half of it goes to the arms, legs, and all other parts of the body. The heart has little flaps of thin but strong material, called valves. Each valve acts somewhat like a little trapdoor; it will open to allow the blood to flow

Fig. 12.—William Harvey demonstrating the circulation of the blood to King Charles the First.

in one direction only. The blood from the left side of the heart is carried to all parts of the body through channels called arteries, which become smaller and smaller, and whose walls become very thin indeed. From these thin-walled, hair-like tubes some of the fluid part of the blood, carrying nourishment, is able to pass to supply the cells of the body.

Oxygen, taken from the air in the lungs, also passes through the walls, as will be explained in the chapter on Respiration. The cells cannot live without oxygen. Through these walls, too, the waste products of the cells and carbon dioxide pass out of the cells into the blood and are carried off. The blood passes on from the tiny thin-walled tubes to the veins, which carry it to the right side of the heart. When the heart contracts, this blood from the right side of the heart passes to the lungs, where the walls of the blood-vessels are also extremely thin. Here the carbon dioxide escapes into the lungs, to be exhaled or breathed out; and a fresh supply of the oxygen which has been breathed in by the lungs is taken up by the blood. The blood thus purified and laden with oxygen returns to the left side of the heart, to be sent again on its journey to all parts of the body.

By the circulation of the blood, then, is meant the movement of the blood round and round in the body. It was William Harvey, an English physician of the reign of Charles the First, who first understood and described the circulation of the blood. King Charles used to watch his experiments with great interest and encouraged him in his work.

To assist the heart and to keep it healthy and strong, there is need of good food, regular exercise, sufficient rest, and fresh air. Injurious and poisonous substances, such as alcohol and tobacco, should be avoided. Infected tonsils and bad teeth should be attended to, for if these things are neglected, the germs and poisons harboured in them are carried through the circulation to all parts of the body, injuring, especially, the walls of the blood-vessels and even the heart itself.

CHAPTER VI

EXERCISE

It has been explained that food is the source of energy for the body, and that good food taken at regular intervals is necessary for health and strength. Without the energy supplied by it we should be unable to work or study or play; for without proper food the muscles, the nerves, the brain, and even the bones would lose their vigour and strength. But food alone is not sufficient to keep the body strong and well. We need in addition regular exercise and fresh air to develop our muscles and keep us healthy.

Fig. 13.—Muscular fibres.

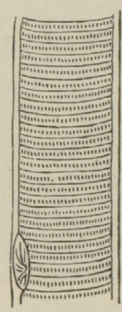

Fig. 14. — Cross section of a fibre of muscle (greatly magnified.)

The muscles are composed of many strands which under the microscope are found to be made up of very minute fibres; and these fibres are divided into separate parts or segments, each one of which has its own nerve and blood supply. The segments have been compared by Sir Arthur Keith to the internal combustion engine of a motorcycle. These little "muscle cylinders," as he calls them, "must be exercised often and well to keep them in repair, for they become stronger and better when given a full amount of work." When these tiny muscle cylinders contract, they give off heat and power just as the engine of a motorcycle does. And just as

the motor engine has a radiator to keep it cool when running, so the human muscle cylinder has its tiny cooling mechanism composed of fluids which surround it.

The muscles also give off waste products which are carried off in the blood stream. These are easily got rid of when we take sufficient exercise in the open air, but if too much exercise is taken, they accumulate and cause the muscles to become stiff and sore. We should, therefore, take enough exercise to keep ourselves fit, but not so much as to cause over-fatigue and exhaustion.

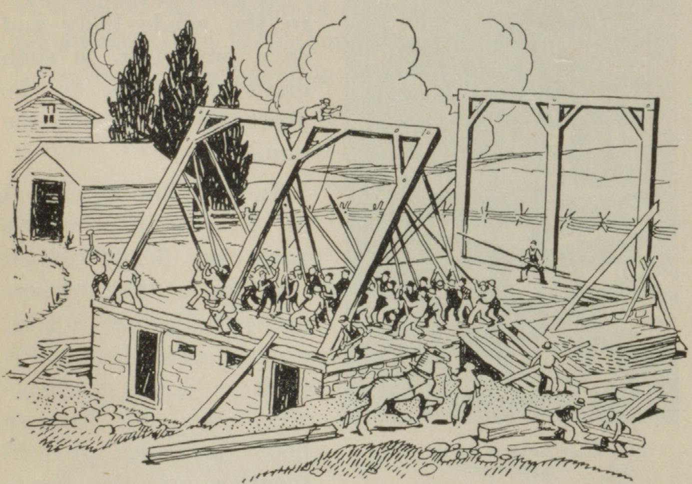

Fig. 15.—A barn raising.

To understand what exercise does for the muscles, it is well to know something about the framework of the body, for it is upon the various parts of this framework that the muscles have to act.

Those of you who have seen a "barn raising" know how the men first erect huge wooden posts, beams, and

rafters, as a framework for the sides and roof. If they did not do so, the barn would collapse with the first big wind storm or after the first heavy fall of snow. In the city the huge skyscraper buildings have their framework made of heavy steel bars; a ship has a framework made of wood or steel; and the human body has a frame-work of bone. This human framework, which is called a skeleton, acts as a support to the whole body and as a protection to such important parts as the heart, the lungs, and the brain.

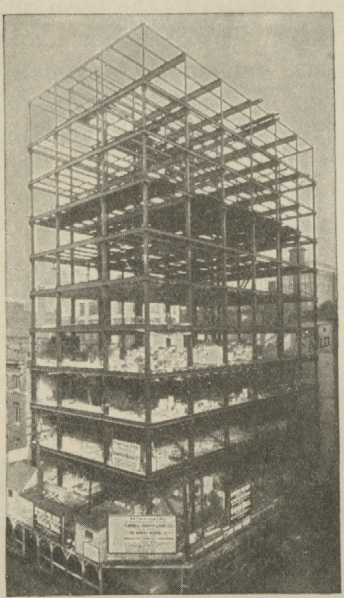

Fig. 16.—The steel framework of a building.

In the buildings and in the ship the various parts are firmly joined together at the corners or joints by nails, screws, or bolts, which make them immovable. In the human body the bones are held together at the joints by very firm strips called ligaments, which at the same time, like the hinges of a door, allow some freedom of movement. The muscles are attached to the bones and help to hold them in position.

Without a skeleton or framework, one could not remain standing; without ligaments and muscles to hold the various bones in position, one would collapse and

fall in a helpless heap upon the floor. The bones and the muscles are equally necessary. Without the one the other would be as useless as the bow without the bowstring.

The muscles are attached at both ends—one end to one bone and the other end to the bone adjoining. Some of the muscles taper off into tough cords, called tendons, where they are attached to the bones. The most prominent of these tendons is found at the back of the foot. It is called the Tendon of Achilles, after a great Greek hero about whom the following curious legend is told:

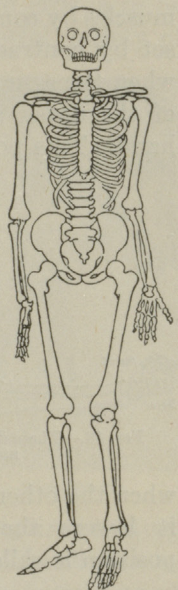
FIG. 17.—Skeleton of a man.

When Achilles was a child, his mother, who wished to make him safe from any wound, immersed him in a famous fountain supposed to protect from harm any part of the body which was dipped under its magic waters. She held Achilles by the heel while she dipped him in, and the part under her fingers was, therefore, not touched by the water.

Years afterwards when Achilles became a man he went to war. For a long time he was safe from all harm. At last in one of his battles he received a wound from an arrow in the back of his heel—the only part of his body not protected by the waters of the magic fountain. The protection given to the rest of his body proved of no avail, and Achilles died from the wound.

When the muscles contract they become shorter, thicker, and firmer. This we may prove by feeling the muscle in front of the arm above the elbow when we double up the fist tightly and raise it towards the shoulder. When the muscles contract, they pull from both ends towards their centre, and as they do so, they pull and move the bones to which they are attached.

The muscles are usually grouped in pairs. One set of muscles by contracting, pulls one way; while the opposing set by contracting, pulls the other way. For example, when the arm is bent at the elbow, the muscle in front of the upper arm contracts and raises the forearm and hand. This position of the arm is called flexion. Then

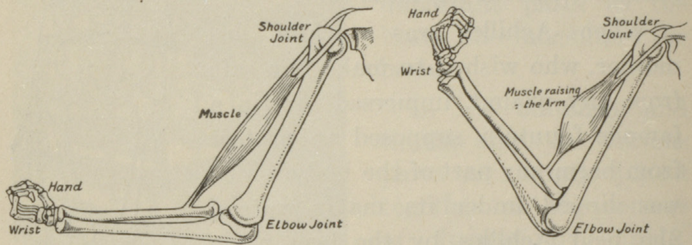

FIG. 18.—These drawings show how the forearm is raised when the biceps muscle in front of the upper arm contracts.

when the other muscle at the back of the arm contracts, it lowers the forearm and hand back again. This position is called extension.

When certain muscles attached to the lower jaw contract, they pull it down and so open the mouth, and when the opposing muscles contract, they pull the lower jaw upward and so close the mouth again. Without the muscles of the lower jaw we could not move it; without the bones of the jaw upon which they act we could not even bite or chew a morsel of food.

In the same way the contraction of our many muscles moving the bones in different parts of our body enables us to run and swim and climb and do all manner of things. We are dependent upon our muscles for almost everything that we do, and so we must be careful to keep them strong and healthy by giving them proper exercise every day.

The best exercise for growing boys and girls is to be found in play. Canadians have a wonderful variety of sports and games from which to choose. In the spring there are such games as marbles, tag, prisoner's base, football, baseball, cricket, paper chases, and lacrosse; in summer such sports as riding, camping, fishing, rowing, paddling, and swimming. Swimming is especially good, as it develops all the large muscles of the body. Like many other good things, however, it may become harmful if indulged in to excess.

Fig. 19.—Girls on skiis.

In winter we have skating, hockey, sleighing, sliding, skiing, snowballing, and other good sports. In all seasons of the year walking and running form the basis of most of our games, and "hiking" in the country is as healthful as it is popular.

We have only to compare the pale faces and frail forms of the children who are continually coddled behind closed windows and doors in overwarm houses with the ruddy faces and sturdy forms of those who play outside, to see the advantage of an outdoor life.

Sports and competitive games give great pleasure and furnish good exercise, and when not overdone should stimulate physical development. But they have their dangers, especially for growing boys and girls. Long-distance races or any other contests should not be engaged in if they cause exhaustion, fainting, sickness of the stomach, or pain in the side. After illness they should not be engaged in at all; and even healthy children should make sure, before entering them, that they are physically fit. Frequently young people are unaware of physical weaknesses. Only a thorough physical

FIG. 20.—A city playground.

examination will reveal them. It is safer, therefore, for young students, as well for those who are more mature, to have such a physical examination before entering competitions. This is now required in all well organized universities and colleges.

Games train the muscles and nerves to work in proper co-ordination. By this we mean that groups of muscles work in harmony with one another, so that there is what we may call "team play" among them; and as a result, our bodies are properly developed. But in addition to this, games develop in boys and girls qualities of leadership, quickness of thought, fairness to opponents, and the habit of good "team play" with others, whether at school, at home, or at play.

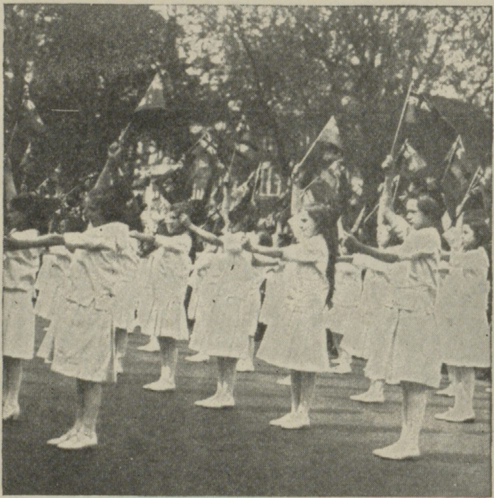

FIG. 21.—A flag drill.

It is by this control and proper co-ordination that famous cricketers, tennis players, golfers, hockey players, and other athletes have succeeded. The baseball player needs wonderful control of muscle, eye, and brain to pitch the curve which baffles the batsman. And it is

by the same co-ordination that artists are enabled to paint their pictures, pianists to play such wonderful music, and mechanics in various trades to do their special work.

To understand the importance of proper co-ordination of the muscles of the body it is only necessary to notice the uncertain gait and peculiar movements of a person who has lost the power of muscular control, through accident or disease. The trembling hand of the young boy who smokes cigarettes, and the staggering gait of a person under the influence of alcohol are other examples of the same thing.

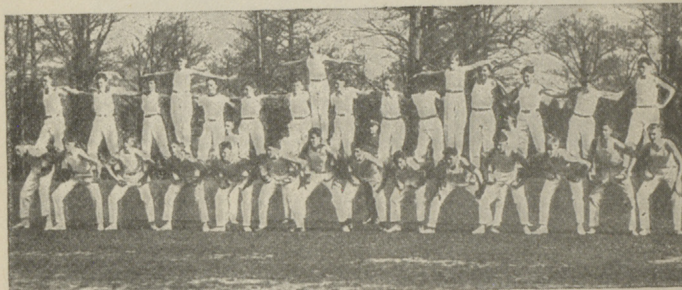

FIG. 22.—A gymnastic drill.

Boys and girls, of course, do not play for the sake of health. They play for fun, and that is as it should be. As a general rule, the more fun they get out of their play the better it is for them. Pleasant exercise is more exhilarating than unpleasant drill, and therefore a better tonic.

Physical training and school drills, however, are very useful forms of exercise whether we like them or not.

They are the means of correcting many physical defects; and if variety is introduced into the drills, they become interesting and enjoyable. We must not forget, too, that whatever form of exercise we prefer, a one-sided development should be avoided. To bring about an all-round physical growth we must take part in many different kinds of games and exercises.

The ancient Greeks trained their bodies by regular exercises. These famous athletes, whose strong bodies and graceful forms were to be seen in the Greek games held over two thousand years ago, have set a standard of physical perfection which has never been surpassed. The beautiful marble statues found in museums the world over were modelled after these athletes by the sculptors of those times, and prove that the Greeks reached a great perfection of body.

If it was possible for the Greeks to develop their bodies to such perfection, it should also be possible for Canadian children to do so. We have in Canada the advantage of a healthful climate, good food, pure water, and unlimited room for exercise.

Work as well as play supplies us with good exercise. Running errands, doing chores around the house and the garden, cutting grass, or shovelling snow may not be the form of exercise the ordinary boy would choose, but such work is good for him. If he could get a little fun out of his work, it would be so much the better, for cheerfulness would raise his spirits and increase the value of the exercise. Tom Sawyer and Huckleberry Finn used their imaginations and enjoyed their work when they pretended it was a game.

It is known that interest in one's exercise increases both endurance and strength. A boy will hold out a fishing-rod at arm's length for a long time without complaining, if he thinks there are any fish to be caught. If we wish to see how his interest in what he is doing

FIG. 23.—Fishing. *From "Green Fields and Running Brooks." Copyright 1898 used by special permission of the publishers, The Bobbs-Merrill Company.*

makes his work easier, let us watch the same boy as he holds out a skein of yarn for his mother to wind. He is using the same muscles as he was using when holding out the fishing-pole, and the yarn is not as heavy as the pole.

But to judge from the expression on his face it would seem to weigh a great deal more. The yarn would be as light as the pole if he had as much interest in holding it. Doubtless the task would seem less tiresome to him if he knew that it was to be used for making a "sport sweater" for him instead of just an ordinary pair of socks.

This illustration shows that interest in one's work makes it easier. It has also been shown that interest in one's play makes the exercise more beneficial. We have, then, two good reasons for taking an interest in our work and in our play.

Some children are not as strong and healthy as others. Through illness, or accident, or misfortune, they are delicate, frail, or lame, and, in consequence, they are unable to enjoy the usual games. These children should not be discouraged, for many of them can improve their bodies and gradually build up their strength. If one has the misfortune to be delicate or lame, and if he is not strong enough to take part in active or violent games, he may learn to excel in those which do not require much strength. There are many games, such as marbles, croquet, jacks, and others requiring little effort but much skill, which should prove good forms of recreation. Walking is one of the best forms of exercise one can take. Some who are unable to run, or play, or climb, may become good swimmers or riders. Lord Byron was lame, but he was a wonderful swimmer. Sir Walter Scott was lame, and yet he became a good horseman. Theodore Roosevelt, once President of the United States, was a delicate youth, but he lived an out-of-doors cowboy life,

and his health improved until he became a healthy, vigorous, and very powerful man.

Charles Dickens, too, was not strong as a child and was rather small for his age. "He never was very good at games, even at marbles and peg-top," but he was fond of watching the other boys play. In time he became a great walker and used to tramp miles over the

Fig. 24.—Gardening.

streets of London as well as in the country. When he was a man, he thought nothing of walking fifteen or twenty miles a day; and it was during these walks that he met with many of the characters which he has made immortal in his stories.

Very delicate children should take heart from these examples of successful men who have grown up strong

and healthy in spite of early handicaps. They have, in fact, used these very handicaps as stepping-stones to their future success.

The study of nature is wonderfully interesting and should be specially so for delicate children. Gardening, photography, and out-of-door sketching should all prove fascinating and healthful. To the boy who keeps his eyes and ears open, nature will be full of interest all the days of his life. Studying nature will take him out of doors among the animals, and birds, and flowers, and it is out of doors with these companions that he will find health and happiness.

CHAPTER VII

REST AND SLEEP

There is a beautiful regularity and a wonderful rhythm in the successive changes in nature. The cold of winter follows the warm days of summer; night with its darkness swallows up the light of day; the foliage blooms in the spring time and shrivels and dies in the fall; the tides of the ocean constantly ebb and flow. And so it is with the various actions taking place in man's body. He breathes rhythmically, first inhaling a breath of air, and then exhaling it. His heart—that most wonderful of pumps—which supplies life and nourishment to every part of the body, contracts and relaxes, contracts and relaxes about seventy-two times every minute. It is able to do this continuous work because, after every contraction, it relaxes for a moment. In other words, it works and then rests. The constant alternation of work and rest in our lives gives power and tone to the whole body.

As has been said in the Chapter on Exercise, waste products accumulate in the muscles if proper rest is not taken after much exertion, and the muscles then stiffen and ache. If an athlete in his training persists in exercising without rest, he becomes over-fatigued or "stale." His muscles then lose their tone and elasticity. He becomes irritable and sleepless, and loses his appetite and his interest in games and sport. His exercise, instead of helping him as it should, to become agile and strong, actually weakens him, because he has been over-taxing his energy. All that this athlete requires is rest.

One's brain may also be abused by constant work with no recreation and rest. A condition called "brain fag"

is the result. A pupil in this state finds himself unable to understand what he is reading. It is very difficult for him to learn even the lessons which he usually finds easy, and he becomes listless and irritable.

It has been found in factories that, when men work eight hours a day, they can produce much more every hour than they can when they work twelve hours a day. Fewer accidents happen, too, when the hours of work are shorter, for the control of the body cannot be maintained as well when it is over-fatigued.

To be most beneficial rest should be taken frequently. Sir Walter Scott, the great story writer, used to work very hard when he was in Edinburgh. All through the winter months he worked into the late hours of the night, and as a result he suffered very much from ill health. During the summer he went into the country and lived in the open air. There he enjoyed the best of health. He failed, however, to realize that a holiday in summer could not make up for his overwork during the winter months, and his life was undoubtedly shortened in consequence. He needed rest and recreation at regular and frequent intervals.

A pupil does not always need to stop work, however, to get rest. Change of occupation will rest one group of muscles without the stopping of work or exercise altogether. So it is with study. A change of subjects sometimes gives the needed relief. The student may figure desperately at arithmetic for a long time and never succeed in solving a problem, but a change to history or literature will relieve the strain, so that on returning to the difficult problem he will find it much easier to solve.

The best kind of rest is that obtained in sleep. Growing girls and boys require sufficient sleep if they are to keep strong and well. Without it they cannot store up the reserve of energy and strength so necessary for them throughout life.

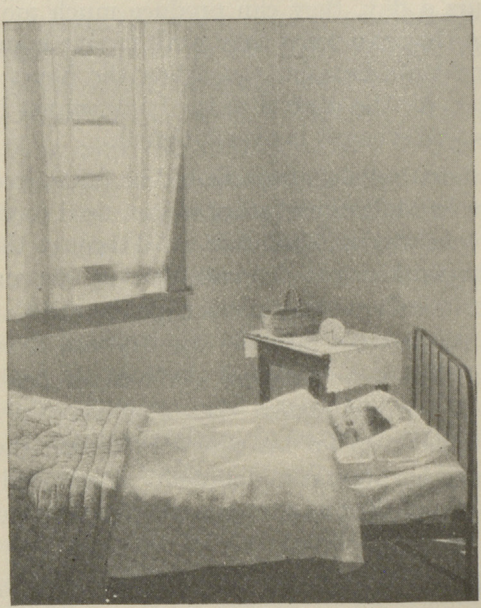

FIG. 25.—"Good Night."

Sleep is a mysterious and wonderful thing. We go to bed with the mind full of the day's memories and thoughts of what is to happen on the morrow; but we gradually become drowsy, our eyelids become heavy, we forget what we were thinking of, and presently we have fallen asleep. Thus we lie the whole night long, knowing nothing, seeing nothing, hearing nothing. For nine or ten hours our tired bodies are at rest.

Yet they are not wholly at rest. During sleep the voluntary muscles, such as those of the arms and legs and back, are inactive; but the involuntary ones, such as those of the heart and lungs and stomach, are still quietly working. The heart still beats, and breathing and digestion still go on during sleep. As the engine of a motor car continues in motion while the car itself is standing still, so in sleep the brain continues to receive some messages and to send out others so necessary for maintaining life, but the sleeper is unaware of what is going on about him.

In the morning we awake in just as mysterious a way as we fell asleep the night before. We open our eyes, look around, move about, and find that our tired limbs are rested, our minds are refreshed, and we are ready for the day.

The value of sufficient sleep cannot be overrated. Children who do not have enough sleep become irritable, pale, and delicate. A boy or a girl twelve years of age needs ten hours sleep every night. A good practice is to go to bed at nine o'clock and get up at seven. Younger children need more than this amount of sleep, but as one gets older a little less will do. Sleep is more refreshing when one goes to bed early, and experience proves that Benjamin Franklin's old saying,

"Early to bed and early to rise,
Makes a man healthy, wealthy, and wise"

is based upon good common sense and the rules of health.

A sound sleep is the best preparation for work, for study, or for play. Athletes always go to bed early when they are in training, since they know how important it is to be in the best of condition for a contest.

The best preparation for an examination also, and for any ordeal, is a good sound sleep.

As one-third of our lives is spent in sleep, it will be well to know a few things which will help us to sleep soundly.

Fresh air in the bedroom makes for restful and healthful sleep. If the bedroom is warm and stuffy, we become hot and thirsty and toss about uncomfortably, and in the morning our heads will not be as clear as if we had slept in a cool and well-ventilated bedroom. A quiet room is a great aid to sound sleep, and light but sufficiently warm bedclothing is helpful. Eating, reading thrilling stories, or playing exciting and boisterous games just before bed-time should all be avoided, since they tend to disturb or prevent our sleep.

While these suggestions may prove useful, it must not be forgotten that "sleep is soundest in one who has become tired in the open air," and that if one is tired enough he can sleep anywhere.

You may remember how Robinson Crusoe, after his shipwreck worked with the rest of the sailors at the oars of the lifeboat, and how the boat was soon overturned by the storm, and Crusoe had to swim for his life. At last, buffeted by the waves and utterly exhausted, he was washed ashore. "Night coming upon me," he writes, "I began with a heavy heart to consider what would be my lot if there were any ravenous beasts in that country, seeing at night they always come around for their prey. All the remedy that offered to my thoughts, at that time, was to get up in a thick bushy tree, like a fir, but thorny, which grew near me, and where I resolved to sit all night, and consider the next day what death I should die, for as yet I saw no prospect

of life. I went to the tree, and getting up into it, endeavoured to place myself so that, if I should fall asleep, I might not fall; and having cut me a short stick, like a truncheon, for my defence, I took up my lodging; and having been excessively fatigued, I fell asleep, and slept as comfortably as I believe few could have done in my condition, and found myself the most refreshed with it that I think I ever was on such an occasion."

CHAPTER VIII

RESPIRATION

The movement of the chest and the taking in and passing out of air from the body, which we call breathing, were of course observed from the earliest times by every one. It was known that breathing was necessary for life. However, it took many, many centuries for men to understand why the invisible air we breathe is just as necessary for our bodies as is water and food. It is not strange that this puzzle was unsolved for centuries, because men did not know what the air we breathe was composed of, nor did they know how the air we breathe out of the lungs differed from that taken in.

One of the great difficulties in regard to the understanding of what air is made up of is that we cannot see the air about us. We cannot handle it as easily as we do water or stone. Robert Boyle, in the seventeenth century, tried by experiments to find out something more about air than was known. He made a pump with which he could suck air from a closed vessel; and he was able to show that a lighted candle or a lump of burning charcoal put into the vessel would go out if the air were removed. He found, also, that small animals put into this vessel could not live long without air. If you put an empty glass fruit-jar over a lighted candle, you may see for yourself that it will not burn long, even though you do not, as Boyle did, remove the air.

It took many years, however, before it was understood why an animal could not live, or why the candle could not burn long without a fresh supply of air.

Gradually men who worked at the problem discovered that there was "something in the air" which animals used up in breathing and which the candle required to keep it burning. This "something" was later known as oxygen.

Joseph Priestley, about 1760, discovered this gas, and found that a flame burned very brightly under a glass vessel as long as oxygen was supplied to it.

He found, too, that if he placed a growing plant in a jar in which a candle had been burning and had gone out for lack of this "something"—oxygen—the plant would live. Indeed, if the plant were left for a few hours in the jar and then removed, it would be possible to light the candle in this jar, and it would burn again for some time. This proved to Priestley that plants give out oxygen to the air.

We now know that wood, candles, coal, all of which consist mainly of a material called carbon, when burned, produce a gas called carbon dioxide. Animals also breathe out this same gas. On the other hand, plants use up this carbon dioxide, and in turn produce oxygen, without which a candle could not burn, and which all animals must take in from the air in order to live.

Thus from Priestley's experiments it was discovered that there is another rhythmic change in nature. Carbon dioxide, which is breathed out by animals, is used by plants, and plants give off oxygen. The oxygen is used by the animals, and in this way each helps the other.

We have seen that oxygen is used up when we breathe. How does this come about? William Harvey, though he knew the blood flowed through the lungs, did not

understand what happened to it there. In order to get a clear idea of this, it is necessary to learn something about the blood itself.

When we cut or scratch a finger, we all know that a red fluid called blood escapes from the wound. Very soon the drops of blood thicken and gradually become jelly-like. In other words, it has formed a clot and is no longer fluid. This is nature's way of stopping the flow of blood.

If a few drops of blood are put into water, it gives a reddish colour to the water. What makes this red colour? If we examine a drop of blood with a microscope, we shall see that it contains many little cells, shaped like the pieces we use in playing checkers except that the flat sides are slightly hollowed out. These are the cells which contain the red colouring substance. So tiny are these cells that there are about sixty million of them in a small thimbleful of blood. If we were to put a large number of these blood cells side by side in a row, it would take 35,000 of them to stretch the width of a twenty-five cent piece.

The microscope would also show us other tiny cells, a little larger than the red ones, called white blood cells. There are one thousand times as many of the red cells as there are of the white. The red and the white cells, called corpuscles, make up about one-half of the blood. The rest of the blood is a clear, yellowish fluid.

What is the work that the millions and millions of the tiny red cells have to do? If you wind an elastic band around your finger, the part of it below the elastic will gradually become darker. What you have done with the elastic is to prevent the blood from flowing back to the

heart through the veins. If the blood does not return to the heart, it cannot be pumped into the lungs to be supplied with oxygen, so that the blood in the finger with the elastic on it has less oxygen and more carbon dioxide than the blood of the fingers of the rest of the hand. This simple experiment shows us that blood containing carbon dioxide is darker than blood containing oxygen, and that the dark red or venous blood going back to the heart has more carbon dioxide and less oxygen than the bright red blood of the arteries which comes from the heart to supply the needs of the body.

The wonderful red colouring matter contained in the red cells is able to take up, or give off very rapidly either carbon dioxide or oxygen. In the lungs, which are made up of countless small air sacks, the red cells hurrying through the narrow thin-walled blood-vessels give off the carbon dioxide and replace it with oxygen in about fifteen seconds. In the muscles and in other parts of the body, the reverse process occurs; that is, oxygen is quickly given off by the red substance in the cells through the thin-walled blood-vessels, and carbon dioxide is quickly taken up and carried off.

What goes on in the body is something like the burning of the fuel in a locomotive. Both require fuel. In place of coal the body requires food, which is changed by the process of digestion into a form which can be used by the various parts of the body. Part of this is stored, and part is used to replace worn-out material. The stored fuel, such as fat and animal starch, is called upon as required, and actually burned, in order to supply the power which keeps the machinery of our bodies working, and to supply heat also. This fire within us has no flame, but the same

thing happens in our bodies as in the fire of the locomotive. If no oxygen is supplied, the locomotive fire goes out. In the same way the slow fire in our bodies requires oxygen. As in the cases of the candle flame and the fire of the engine carbon dioxide is given off, so in our bodies this same gas is formed and is carried away by means of the blood stream, lungs, and breath. We must remember, however, that though in some respects the body is like a locomotive, it is not nearly as simple as an engine or as any other machine ever constructed by human hands. It is much more complicated and much more marvellous.

CHAPTER IX

FRESH AIR AND VENTILATION

Travelling down the beautiful St. Lawrence River one day, a passenger decided to go into the cabin for a time to read. But the air was so bad there and the odours

Fig. 26.—A scene on the St. Lawrence River. *Courtesy of the Canada Steamship Lines.*

were so strong that he soon came out again. While he was leaning against the rail watching the magnificent scenery, the Captain passed along the deck.

"Pretty stuffy cabin you have in there, Captain," said the passenger. The captain, who was a ruddy-faced old sailor, laughed heartily. "Stuffy!" he ex-

claimed. "There's no accounting for tastes. It reminds me of the old rhyme;

Pease porridge hot,
Pease porridge cold,
Pease porridge in the pot,
Nine days old.
Some like it hot,
Some like it cold,
Some like it in the pot,
Nine days old.

That's just the way with our passengers," he continued. "Some like the cabin hot, some like it cold, and some like the air in it nine days old."

Stephen Leacock in *Sunshine Sketches of a Little Town*, refers to the same thing in his story of an excursion on the *Mariposa Belle.* "The women, the older ones," he says, "all gravitated into the cabin on the lower deck, and by getting round the table with needlework, and with all the windows shut, they soon had it, as they said themselves, just like home."

What is true of the cabin of the *Mariposa Belle* is true of many homes.

In that splendid story of Quebec, *Maria Chapdelaine*, there is a description of the preparation of a country home against the coming winter's cold. "The men, armed with hammers and nails, went round the outside of the house, nailing up, and closing chinks. . . . ; within, the women forced rags into the crevices and pasted upon the wainscotting at the north-west side old newspapers." In the neighbourhood of Lake St. John, in the northern part of Quebec, where the scene of this story is laid, there may be good reason for taking these precautions against the piercing cold of the long winters.

In many parts of Ontario, however, and in many other parts of Canada, no such precautions are needed.

We cannot live without air. Every few moments we must draw in a fresh breath of it. Place your watch on your desk and count how many times you breathe in a minute. With practice, to be sure, you can learn to hold your breath for two or three minutes, as pearl divers do. If they wish to remain longer under water, they must have some special means of getting air. A diver's suit is made of heavy canvas and rubber, and it has a headpiece or helmet of steel. To this helmet is

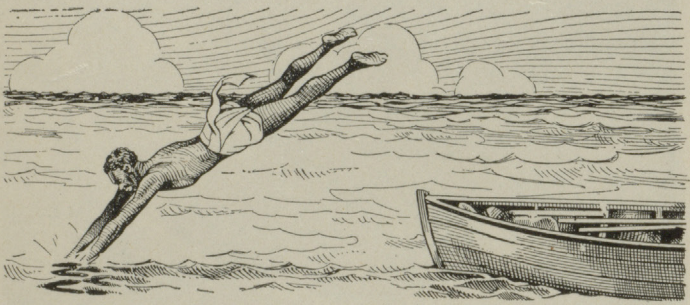

Fig. 27.—Diving for pearls.

attached one tube through which fresh air is pumped down from above, and a second tube through which used air escapes to the surface. If the air tube were to break, or if those above were to forget to pump, the diver would faint and die from lack of air.

It is necessary for us not only to have air but to have fresh air. Many people live in poorly ventilated rooms, sleep in stuffy bedrooms, work in dusty workshops and stores, and as a result suffer in health.

It has been found in certain factories that, when the ventilation was improved, the workers were able to increase greatly the amount of work done.

Good ventilation, therefore, increases one's power to work.

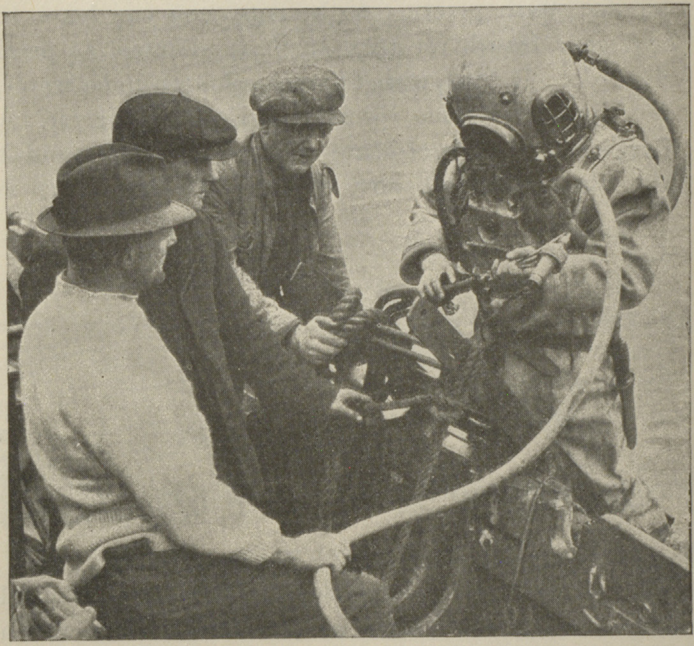

FIG. 28.—A diver in his diving suit.

One can preserve fruit by sealing it in jars, for fruit keeps best without air, but one cannot preserve children by keeping them in tightly sealed rooms. Children must have fresh air. Even the Eskimo in the sub-Arctic regions ventilates his little snow hut or igloo by an opening in the roof which he calls the nose. Accord-

ing to Leonard Hill, one of Britain's authorities on ventilation, "Good ventilation and circulating air in buildings, and out-of-door living are needed for vigorous health;" and again, "Cool breezes blowing round the head, the radiant heat of the sun, and a warm ground to stand on, are the ideal outdoor conditions."

It is sometimes difficult to have ideal conditions indoors. We should try, however, to secure a temperature

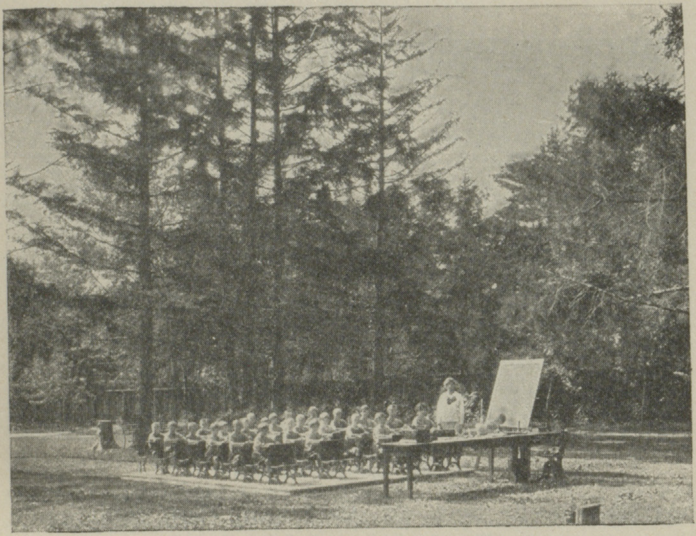

FIG. 29.—An outdoor school.

ranging from sixty-five to seventy degrees and to have a constant supply of fresh air that is not too dry. We should try, too, to keep the air in motion, but at the same time to avoid cold draughts near the floor. When the feet are chilled by a draught blowing over a cold floor and the head is surrounded by warm stagnant air, we are likely to suffer from colds.

Since we spend no less than a third of our lives in bed, it is very important that our bedrooms should be properly ventilated. Sleeping in the open air, whether in tents or on verandahs, or in bedrooms with wide open windows, is very healthful. At the Preventoria in various parts of Canada, where delicate boys and girls are cared for, the children always sleep in the open air. When they arrive they are generally pale, undernourished, and delicate; but, sleeping on wide verandahs

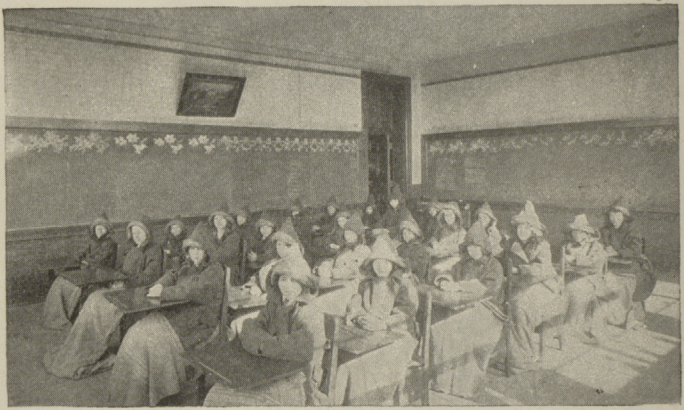

FIG. 30.—Open-air classroom.

exposed to the open air, they soon show remarkable improvement. They gain in weight, colour, and strength. Some of this improvement is doubtless due to the rest, the regular meals, and the good food; but the fresh air is very important. If sleeping in the fresh air is good for delicate children, it is good for all.

Open-air classrooms show further the good effect of fresh air upon school children. It might be thought that children who go to school out of doors will catch

many colds; but when the weather is cold, these children wear extra wraps to keep them warm, and experience has proved that they have fewer colds and are more healthy than if they spent the whole day indoors.

Fresh air makes one sleep more soundly and prevents the headaches which so frequently attack those who sleep in close, stuffy bedrooms. Some people seem to be afraid of night air; they should remember that night air is as good as the air in the daytime.

The easiest way to ventilate a room is to open the window at the bottom and at the top. A simple method of ventilation is to have a strip of board, or glass, placed in a slanting position on the lower sill to direct the incoming air upwards and so prevent a draught. The opening at the top is to allow the bad air to escape. This method of ventilation provides the necessary circulation of air.

The reason why impure air which we have just breathed out rises, is not because it is impure, but because it is warmer air than that of the rest of the room. Warm air is lighter than cool air. If we allow it time to cool, it will gradually sink to the bottom again. Miners who have to go down into the depths of the earth are well aware that they could not live down there unless the mines were properly ventilated by air-shafts. Accordingly, a proper circulation of fresh air is maintained in all mines.

It used to be thought that it was the presence in the air of carbon dioxide gas which made it seem stuffy and close; but now it is known that stuffiness is largely due to the lack of motion in the air. Nothing is more necessary for good ventilation than a free circulation of air. In Eastern countries, where it is very hot and the

air is often still, natives are employed to keep large fans moving in the room when there is no breeze from outside. For us, too, fans are useful on a sultry day. If we feel oppressed by the stagnant air in a room, the motion of the air caused by an electric fan will very often revive us.

In considering the ventilation of a room we should ask ourselves the following questions: Is there a sufficient supply of fresh air free from dust and smoke? Is this air at the proper temperature? Does it contain the right amount of moisture? Is it kept in motion?

One has only to observe the difference between those who live and work outside and those who live inside to be convinced of the value of fresh air. Those who live outside are more vigorous and healthy, and they have a better colour than those who live inside.

The value of fresh air and ventilation was shown by its effects upon the Canadian troops while in England. During the first year of the war they were camped in tents on Salisbury Plain where the weather was extremely wet and uncomfortable, but they were in excellent health. As soon as they were moved into huts, however, colds and sore throats spread rapidly, and other diseases also occurred.

To receive the greatest benefit from our breathing, we should breathe deeply. This will help to expand the lungs, so that they can take in and give out a larger volume of air. Since more oxygen enters the lungs in deep breathing and more carbon-dioxide gas leaves the lungs, there will be a more rapid purifying of the blood. Deep breathing, then, increases the efficiency of the lungs, and thus helps in that wonderful process of respiration so necessary for our life and health.

Deep-breathing exercises are useful at times, but the best means of training ourselves to breathe deeply is by taking sufficient exercise. The exercise of our legs often does more to assist deep breathing and develop the lungs than any special form of breathing exercises.

We should also form the habit of breathing through the nose, although during violent exercise this may be impossible. The lining membrane of the nose is wrinkled and winding, which gives it a large surface. This lining is well supplied with blood-vessels. These warm the incoming air to the temperature of the body. The lining of the nostrils near their openings is also supplied with very fine hairs, which act as filters and so help to prevent dust and germs from entering the lungs.

If you find it difficult to breathe through the nose, you should see the doctor. The difficulty may be due to enlarged tonsils or to adenoids—growths at the back of the nose and throat—which often seriously affect the health.

For health, strength, and good looks, the open-air life is the best life for all. Especially should boys and girls, whether delicate or strong, be out of doors as long and as often every fine day as their duties at home and at school will allow. Even when the weather is cold, wet, or stormy, if you are properly clothed, a brisk walk or run will be beneficial, and nothing will keep up your spirits like getting out of doors in the fresh air every day.

CHAPTER X

POSTURE

THERE is always an interested group of people at the Fall Fairs watching the judging of live stock. A similar group is always found at the dog kennels. It seems very difficult at times to decide which horse, or cow, or dog should win the prize. We may be sure, however, that

FIG. 31.—A prize winner.

the judges will never pin the red ribbon, denoting the first prize, upon an animal which has not a good posture.

Notice how all the prize animals hold up their heads and how gracefully they stand. They neither crouch, nor stand awkwardly and lazily upon three legs, but they stand erect and show confidence and strength.

Good posture is just as important for us as it is for animals. It is almost as essential for good health as it is for good appearance; and the state of a person's physical fitness is often shown by his attitude in standing, sitting, or walking.

Correct posture depends not only upon the proper formation of the bones and the strength of their ligaments, but also upon the right use of the muscles which control them. Of all the bones taking part in holding us erect those of the spine are the most important. The spinal column or backbone, as it is usually called, is composed of twenty-four separate bones set one upon another. They are held together by ligaments; but without the aid of the muscles attached to them the spine would bend under the weight of the head and body, and we should easily topple over.

When one goes to sleep while sitting up in a chair, the head nods, because the muscles which have been holding it up relax, thus letting the head drop forward. If one were to fall asleep while standing up, he would sag at the knees owing to the relaxation of the muscles of the legs, and he would fall in a heap on the floor. This shows that standing or sitting requires muscular effort, and this is why one becomes tired when standing or sitting for too long a time without rest. Especially is this so when one remains standing or sitting for a long time in one position; this keeps certain groups of muscles at a tension, and he becomes restless and fidgety, because his muscles are tired and because the strain is too great upon them.

Restlessness in children, then, is quite natural. Their desire to change their position frequently is nature's way of easing one set of muscles by using another. A

change of posture is restful, because it allows of better circulation through the fatigued muscles and so refreshes them.

Good posture is more restful than poor posture. If we work while standing or sitting in an incorrect, cramped, or awkward position, the body becomes more easily fatigued. The muscles which hold it erect work in pairs, and when we stand erect, each set of muscles is doing the same amount of work without strain. When we are stooped over, standing or sitting in an awkward position, however, certain muscles are overworked and are under

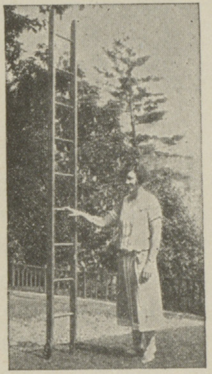

Fig. 32.—Ladder held in perpendicular position.

Fig. 33.—Ladder held in leaning position.

a constant strain. To prove this, stand upon one foot for a short time, and notice how tired you become because of the strain upon the muscles in trying to balance your body. Another experiment which will prove this is to hold a ladder in a perpendicular position and in a slanting position. Stand a ladder up straight and you can hold it easily with one hand. If it is allowed to drop

ever so little forward, you will require more effort to hold it; and if it is allowed to lean forward very far, you cannot keep it from falling.

In much the same way the spinal column is held erect by the muscles of the back. The more one leans forward the more effort is required. Sit, stand, and walk in a correct position, therefore, to avoid this strain on the muscles and needless fatigue.

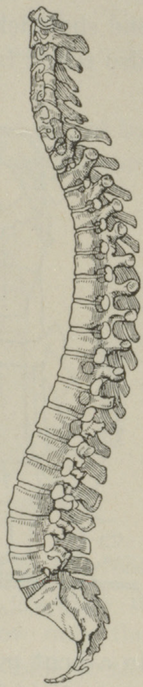

FIG. 34. — The spinal column.

The erect posture will also allow more room and freedom for the lungs to expand properly. Try to breathe deeply when stooped over in a cramped position. Then straighten up and breathe deeply. In which position can you breathe more easily? What seemed to prevent ease of breathing when you were stooped over? When we breathe in, the ribs which surround the lungs like a cage move up. At the same time the floor of the chest cavity, which is called the diaphragm, lowers. When this lowers and the ribs are raised, a vacuum or empty space is created in the chest cavity, and air rushes in. If we sit or stand in a cramped position, the movements are restricted by the pressure on the organs of the body, and we cannot breathe as deeply as when we are in a correct posture. By removing the pressure on the stomach and other organs of the body, we allow them more freedom of movement. Correct posture, then, is an aid towards health, strength, and good appearance.

The spinal column has natural, graceful curves. If these are exaggerated, they become defects, known as curvatures, and are a source of weakness. To avoid curvatures we should walk and sit erect. For example, we should not carry a heavy load always over one shoulder, but should shift it frequently, or else we ought to divide the burden into two parcels, carrying one over each shoulder; otherwise the weight will gradually lower one shoulder and so bend the spine. Round shoulders also result from constant stooping, whether in our walk or over our books. As our posture is affected by wrong attitudes even while we sleep, we should avoid high pillows, which cause us to curl up into bad positions.

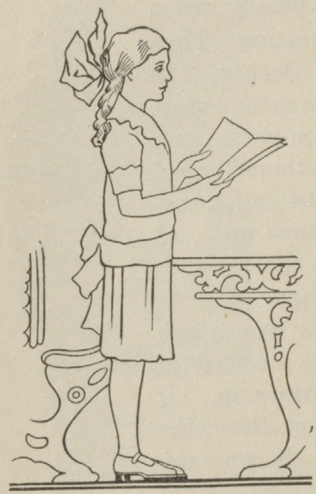

Fig. 35.—A good posture.

It is especially important for growing boys and girls to cultivate a correct posture while they are young, in order that the muscles may develop evenly and so promote a strong and graceful figure. It is much the same with us as it is with trees. If a young tree is tied in a bent position, it will grow up crooked; but if it is started straight, it will grow up straight. "Just as the twig is bent the tree's inclined," said the great poet, Alexander Pope, who must have thought of this often, for he himself was deformed from birth.

We should stand erect with the head up and the shoulders back, the chest out, the stomach in, and the back upright but retaining its natural curves. We should stand easily poised, with our weight resting mainly on the forward part of the foot, not upon the heel. Any one with a tendency to weak arches or flat feet should stand and walk keeping the feet straight forward and parallel. This helps to strengthen the muscles which hold up the arches of the feet. The average person should walk with the toes turned only slightly outward.

You may know whether your feet are flat or not by wetting the soles of your feet and walking on the bare

FIG. 36.–Impression of a flat foot.

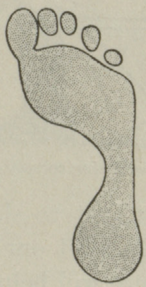

FIG. 37.–Impression of a normal foot.

floor. If the marks show the complete sole of the foot imprinted there, you have fallen arches, or what is usually termed flat feet. If the marks show only the front part of the foot, the heel, and the outside of the foot, then you have not fallen arches.

A pupil should sit with the back erect, and he should sit far back in the chair, not permitting himself to slip down so that his weight is upon his back and shoulders.

Daily calisthenics and school drills should help to correct any faults of posture.

A good posture makes us look and feel at our best and stiffens our courage as well. Idleness often goes hand in hand with a slouchy carriage. We should not

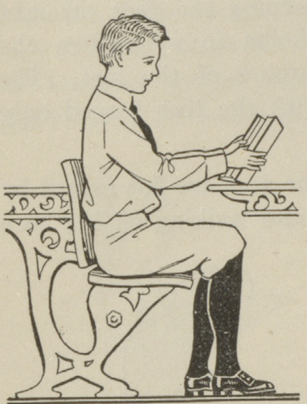

FIG. 38.—Sitting correctly.

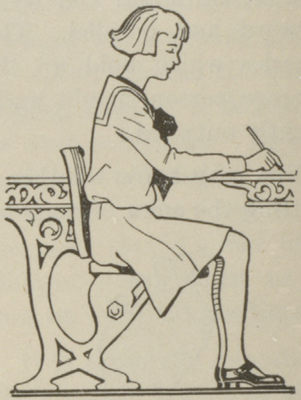

FIG. 39.—A good position for writing.

be content just to slouch through life, but we should aim high and let our posture reflect our ambitions. A good posture will help us all to face our daily tasks. It gives us an advantage wherever we go, for it improves our appearance and our health, and it adds to our self-confidence—so necessary for success in life.

CHAPTER XI

BATHING AND CLEANLINESS

Sailors in the tropics sometimes let down into the water a big sail held at each corner by a rope, so that they may have a swim. When the sail fills with water, it forms a swimming pool which protects them from sharks and saves them from drowning. Swimming is as great fun for the sailors as it is for boys and girls the world over.

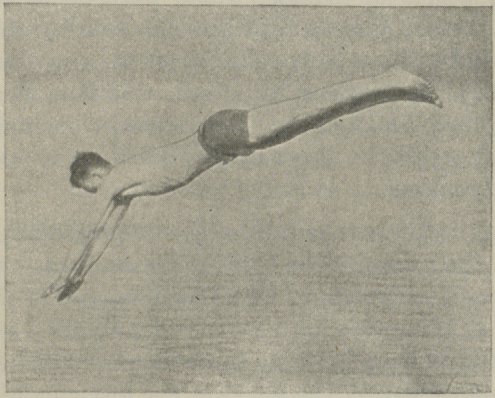

Fig. 40.—A dive into the deep.

Swimming is healthful as an exercise, and so is bathing of any kind; but frequent baths in a tub are not what an ordinary boy calls fun. A tub is, naturally, not as exciting as a river or a lake; but often we cannot have these open places, for they are not at hand; and they are, of course, all frozen over in the winter. Yet we need to bathe in winter as well as in summer.

The greatest nations have been the greatest bathers. The Greeks and the Romans had the finest baths in the

history of the world—beautiful marble palaces costing fabulous sums of money. The British are a nation of bathers. The Japanese soldiers, during the war between Japan and Russia, resorted to frequent bathing, and by their cleanliness helped to prevent certain diseases from breaking out among them.

While the skin is a great means of protection, it is not like a suit of armour which protects one against cuts and wounds from swords and knives, nor is the skin able to stop bullets. It does, however, if unbroken, keep out germs of disease, which may be as fatal as bullets. But if the skin is broken, even by the prick of a pin or by the merest scratch, germs may enter and blood poisoning may set in. From this it is clear that the skin must be kept clean by frequent bathing, and, as far as possible, it must be protected from becoming scratched and cut.

The skin regulates the heat of the body by the evaporation of the perspiration which comes from the tiny sweat glands in the skin. The blood-vessels in the skin dilate or get larger in warm weather and after exercise. More blood is thus brought to the surface of the body, where it is cooled by the air. On the other hand, when the weather is cold or when we are at rest, the blood-vessels contract or get smaller. A healthy skin responds better to these conditions than does an unhealthy skin, and is, therefore, better able to regulate the heat of the body, and so make us comfortable.

Washing with soap and water and rubbing briskly with a coarse towel increase the circulation of the blood in the skin and keep the little pores of the sweat glands open. The rubbing removes all the dried and oily material clinging to the skin, and so helps to keep it clean.

For cleanliness, health, and also refreshment of the whole body a warm bath should be taken once or twice a week.

Many people take a cold bath every morning, and if this agrees with them and causes a healthy reaction, that is, a general feeling of well-being, and brings the skin to a ruddy glow, it is good for them. Such bathing makes the skin more hardy, and so helps to prevent them from catching cold, because it trains the skin to meet the changes in heat and cold quickly. It also helps the circulation in the inner parts of the body, and so strengthens the muscles and improves the general health. Athletes always try to get a bath and a rub after their exercise. If, on the other hand, a cold bath produces a chilly, depressed feeling and a blue-looking skin, it is wiser to avoid it. A tepid or lukewarm bath is preferable for those on whom the cold bath has such effects.

While cleanliness is a good thing, there is no credit in being always clean. The boy who never has unclean hands is the boy who never plays any strenuous games or does any real work. No one likes the fellow who is afraid to dig in the garden, or go fishing, or play football for fear of spoiling his appearance. Good honest dirt acquired in work or play is not something to be ashamed of; and no one who is worth anything will draw back from a task merely because it will soil his hands.

The mark of the cleanly person is not that he is never dirty, but that as soon as a dirty job is finished, he immediately makes himself clean. The hands, especially, should be washed often, and always before eating. No one with a sense of cleanliness would like to touch his food with dirty fingers; but that is not the only reason for washing the hands before meals. Dirt itself

is unpleasant but harmless. Along with the dirt, however, there may be very dangerous germs. If the hands are not washed, these germs may be conveyed to the mouth with the food, and so may enter the body.

If one has received a cut or a scratch, there is very special reason for cleanliness. In a later Chapter you will learn how to treat a cut, but the main thing to remember is that a wound will heal more readily when the skin is clean and healthy. Before operating, a modern surgeon scrubs his hands, boils his instruments, and makes sure that all the dressings for the wound are perfectly clean. He takes all these precautions because he knows that, if any germs gets into the patient's wound, blood poisoning, with great suffering, or even death, may result. If the cut or scratch is only a small one, there is, of course, much less danger; but even a small sore will heal more quickly if it is kept clean.

When bathing, soap should be used as well as water, for soap is a good cleanser. One of the most precious things to the natives of the South Sea Islands is a piece of soap. Sailors who have been there will tell you that they can obtain war clubs, beautiful sea-shells, and curios of many descriptions from the natives, merely for a cake of soap. Some of our Canadian boys and girls might do well to take a lesson from these simple natives of the South Sea Islands, and learn to appreciate the value of a cake of soap.

HAIR

The best way to take care of the hair is to wash and brush it regularly. Boys should wash their heads every week. Girls may wash theirs less frequently, for as a rule they seldom get it into the condition requiring such frequent washing as do the more active boys. Frequent

brushing of the hair also improves it, for this stimulates the circulation of the scalp, and so makes the hair more healthy.

NAILS

The nails which protect our fingers and our toes should be trimmed every few days, otherwise they become too long and are apt to catch in things and break.

As our finger nails are useful in picking things up as well as in protecting our fingers, we should not trim them too short. In trimming the nails, the best thing to use is a small nail file, for it does the work evenly. With scissors or a knife one may often cut too deeply. When cleaning the nails, it is better to use the blunt point of the file than a sharp-pointed knife. The knife often scratches the tender flesh under the nails, leaving it open and liable to infection by germs.

Some have the unfortunate habit of biting their nails. This not only spoils the appearance of the hand, but it makes the nails practically useless.

HANDS

If these suggestions seem trivial, remember that they are given for the purpose, largely, of guarding the hands. Our hands are the most wonderful instruments in the world. No machine, tool, or contrivance ever invented can do such a marvellous variety of things. Most of us live by the work of our hands. Our work may be rough and heavy or it may be delicate and fine; it may be the guiding of the heavy handles of the plough, or the delicate instrument of the surgeon. But if our hands are trained by use, and not disabled, they can always be relied upon.

Musicians have been known to insure their hands for thousands of dollars. Our hands, also, may be insured, and the best insurance, or protection, is in cleanliness and care.

CHAPTER XII

CLOTHING

THE skins of bears, dogs, cats, and other animals are covered with fur. Birds are protected by feathers, fish have scales, and even turtles are protected by their shells. The human body, however, is covered with a delicate skin having neither fur, feathers, scales, nor a shell to protect it. It is necessary, then, for us to wear clothing to keep us warm in winter and to protect us from the sun's hot rays in the summer. In early Canadian times the Indians in winter covered themselves with the skins of animals and wore stockings and shoes or moccasins made of skins, but in summer they went barefoot and wore very little clothing at all. We can accustom ourselves to a great variety of clothing, and so, very often, foolishly think more of its appearance than of its weight and quality. As a consequence, we often suffer discomfort and even ill health.

Our clothing should be worn loose, so that it may interfere as little as possible with the ventilation of the skin, for as we saw in a previous Chapter, the heated blood is carried to the skin after exercise to be cooled, and thus to regulate the heat of the body. Summer clothing, especially, should be worn loose at the arms and knees, to permit of this free ventilation and evaporation. It should be light in colour to help keep us cool, for light colours, and especially white, reflect the rays of the sun, instead of absorbing them as do dark or black clothes. For example, the natives of India, where it is very hot, wear white clothing, and so do the Europeans who live there. Experience has taught them that

light-coloured clothing in the heat of the tropical sun is cooler than dark clothing.

To illustrate this we may try this simple experiment. On some sunny winter's day take two pieces of cloth, of the same kind of material, one of which is dark and the other white, and place them side by side on the snow. In a little while lift them up and you will find that the snow under the dark cloth has melted more than the snow under the white. This is because the dark cloth absorbs the rays of the sun, while the white cloth turns them aside.

It is often the case that we keep our homes much too warm in winter. They should be kept at a proper temperature, which is about sixty-five degrees, and this would permit us to wear in the house clothing of medium weight, and be comfortable. When we go out we should have warm overcoats, warm outer garments, and boots or shoes and stockings which give good protection and comfort to the feet and legs.

The more vigorous the exercise we take, the more need we have for clothing light in weight. It should never be so heavy and warm that we do not wish to exercise, but it should be the lightest we can wear without being cold.

Boots which fit properly are necessary for comfort and for health. When buying a new pair of boots, we should be sure to choose those which are large enough and give us comfort. A pair with low heels and with plenty of room for the toes are to be preferred to boots with high heels, having narrow and pointed toes. High heels cause a strain upon the arch of the foot, and so tire the wearer quickly. The toes are pushed down into the toe-cap by the weight of the body, and this makes them sore. Corns, ingrowing nails, blisters,

and other troubles all arise from badly fitting boots. For walking, running, working, and playing, "party" shoes are out of place. A straight-last boot, which is one with the inner side of the boot almost straight, is the most comfortable kind to wear. Comfortable boots or shoes help us to enjoy our games and exercises.

Most people think that rubbers or goloshes are a nuisance, and many do not like to wear them. But to wear wet boots all day or to sit with damp feet is very harmful; and since in wet, slushy weather we cannot keep our boots or our feet dry without rubbers, we should always wear them when necessary. But they should be removed when in school or in the home, because, if they are worn then, they will cause the feet to become tender.

Tight clothing of any kind we should always avoid. Tight boots, tight garters, tight belts, tight collars, and tight hats are all harmful, because they prevent proper circulation and do not allow sufficient room for expansion. When one walks for a long time, especially in hot weather, the feet swell, and then tight boots begin to pinch. When one runs, the veins of the leg swell if the garter is too tight. Since we breathe with the assistance of the diaphragm as well as of the walls of the chest, we need a free play of these parts for proper breathing. A tight belt does not permit of this, and it also causes too much pressure upon the stomach. A tight collar frequently causes headache and so does a tight hat, for they both press upon the blood-vessels and interfere with the proper circulation of the blood in the head and the scalp.

In buying clothing and boots we should remember that, while it is natural and right to desire becoming clothes, we should choose them first of all for comfort and health.

CHAPTER XIII

SUNLIGHT

It is said that Diogenes, the Greek Philosopher, lived in a tub. One day as he was sitting there, Alexander the Great in passing entered into conversation with him and asked him if there was anything he would like. Diogenes craved from Alexander the single boon that he should not stand between him and the sun.

Imagine a poor old philosopher who lived in a tub asking the greatest monarch of his age to stand out of his sunlight!

Diogenes, however, thought the sunlight was of great value to him; and, after all, he was not so foolish as he seemed, for sunlight is a marvellous thing.

After a long winter and the dreary winds and rains of March, spring is always welcome. With his magic wand the sun bids the song birds to return from the South, the buds to open, and the wild flowers to bloom. Sunshine makes the world happy and gay.

Have you ever wondered how far away the sun is or how large it is? It is ninety-three million miles distant from the earth and is more than a million times as large. It has been found that if a message is sent by wireless around the earth, it will go completely around in a time almost too short to measure. Light travels through space from the sun to us at the same rate as the wireless message, 186,000 miles in one second, and if the sun were suddenly to disappear, it would take about eight minutes before we could perceive that it was no longer shining.

If it did disappear, nothing could live or grow on the earth. The rays of the sun have great power over living things in many marvellous ways.

How great is this power you may appreciate from the fact that when the sun shines on a 200-acre farm, about the same power is produced as is obtained from Niagara Falls in the form of electricity. Only a very small portion of Niagara water-power is turned into electricity, yet our street-cars are run and our lighting and cooking may be done by the electrical power which is developed at the mighty waterfall. Or to put it in another way, if a giant burning-glass could be made to bring to a point all the light and heat of the sun that falls on one acre of land, the power, if used to turn water into steam, would run twenty locomotives, each with a train of freight cars.

We have not yet been able to harness the power of the sun's rays as we do the power of Niagara. However, the green leaves of plants and trees are able in some mysterious way to use it. Sunlight makes them grow in height and strength and makes them develop flowers, fruit, and nuts. Indeed all the good things of the vegetable kingdom which help to nourish our bodies are products of sunlight. Even the coal and the wood which we burn in winter to keep us warm are made from plants which have stored the sunlight. Try to grow a potato in the dark, and you will notice that its leaves are small and whitish, and that its stem is tender and frail. Compare it with a sturdy potato plant from the garden, and you will see how sickly a plant is without the sun.

Perhaps you have observed that a plant set near the window will seek the light by bending towards it, and that to keep it growing straight it must be turned a

little every day. Boys and girls, like plants, must have sunlight, or like plants grown in darkness they will become puny and weak.

The sun sends out three kinds of rays. One kind is made up of rays that we can feel but cannot see; these are known as heat rays. They are similar to the first rays given off by a poker when one end is held in a fire. Before the poker begins to glow, heat waves come from it, and we say the poker is growing hot. When the poker begins to glow, however, we know that, in addition to rays of heat, rays of a second kind are being given off. Our eyes can see these light rays. Besides heat rays and light rays, the sun sends out rays which we cannot see. These have remarkable powers and greatly influence our bodies. They are called the ultra-violet rays.

You may have seen in photographers' studios electric lamps which give forth a violet light. With this light satisfactory pictures may be taken even at night. To our eyes the sunlight seems much brighter than the photographer's lamp, but to the photographic plate it is just the opposite. The plate "sees" rays that our eyes do not detect. These are the ultra-violet rays already mentioned. The sun also sends out these rays, but there are not so many of them in proportion to its size as in the photographers' electric lamps.

These ultra-violet rays, to which the photographic plate is sensitive, but which our eyes cannot see, are very important to us. It is these which in a mysterious way act on our skin and help the body to make strong bones and hard teeth. However, although they are very powerful rays, they cannot pass through the smoky atmosphere of a city very

readily. Even the clearest window-glass prevents them entirely from reaching us when we are indoors. This is true even if we stand in the very centre of the bright sunlight streaming through the closed windows of a room. If, therefore, growing children are not out of doors in the sunshine and do not drink sufficient milk, the bones and teeth do not grow strong and hard. The teeth become badly formed and decay very easily, and the bones bend under the weight of the

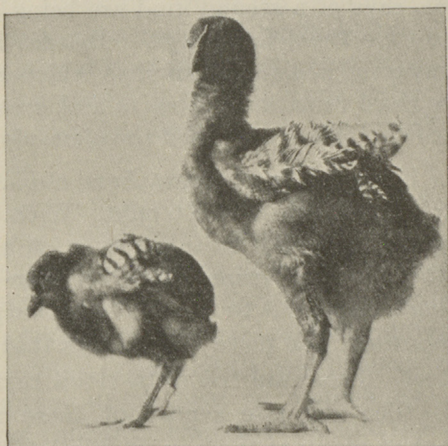

FIG. 41.—These chickens are the same age and received the same food. The bigger one was put in the sunlight every day; the smaller one was not.

body. In countries where there is not much sunlight, and especially where children are living in dark streets of big cities, they often develop a condition of badly formed bones and teeth. This is a disease called rickets. Even in Canada, especially in winter, it is not uncommon. Such children can easily be cured, not only by exposing

them to full sunlight in the open air, but also in our hospitals, by allowing ultra-violet rays to fall upon them —rays which are similar to those made by the photographers' lamps. It is these rays which produce a coat of tan. And this coat of tan is in turn an advantage. It means that the boy or girl who has it has been out in the sun so much that these peculiar rays have produced a brown substance in the skin, which, like the window-glass, acts as a screen to prevent the too severe action of these powerful rays. The tan has been well called "a healthy coat of tan."

During the winter in Canada there are few of these bone-strengthening ultra-violet rays in the sunlight, because the sun is not so high in the sky as in summer, and the rays come to us, therefore, in a slanting direction. This means that the sun's rays must pass through more air in winter than if shining almost above us, and in consequence fewer ultra-violet rays reach the earth.

Green vegetables are able to store these rays in such a way as to be beneficial to us, provided, of course, that the vegetables have been grown in the open air and not in a greenhouse under glass, which holds back ultra-violet rays. It has long been known, however, that cod-liver oil, too, will strengthen teeth and bones just as well as vegetables grown in sunlight do. Probably this is due to the fact that the codfish have eaten green sea-food which had stored the ultra-violet rays.

Sunlight also helps to cure some forms of tuberculosis. In many places, especially in Switzerland, children suffering from this disease are treated by exposure to the sun's rays. At first part of the body is exposed for a short time only, but very gradually the whole surface

of the body is allowed to take on a deep coat of tan. In the course of time the disease is often cured. The germs of the disease are, however, not killed in the body by the sunlight, for the ultra-violet rays cannot pass even through the skin. The beneficial action is due rather to the improvement which the sunlight and these rays produce in the general health of the children.

Sunlight aids in preventing the spread of disease by destroying germs if they are directly exposed to its rays. For instance, the germs which cause tuberculosis are killed in an hour or two by direct sunlight. We should therefore let plenty of sunshine into our houses. Sunlight is nature's great cleanser.

Growing boys and girls should play out of doors as much as possible, allowing arms, legs, and face to be bare in warm weather, so that they may benefit from the health-giving invisible rays of the sunlight.

CHAPTER XIV

OUR EYESIGHT

OUR eyesight is a great blessing. Upon it we are dependent for much of the joy of living. If we could not see, we should miss some of the best things in life; the wonders and beauties of nature—the woods, the streams, the birds, the flowers, and the animals would to a large extent be lost to us. We could play but little, and should need long and special training to do good work.

There is nothing more marvellous than the eye. The way the image of your dog "Sport" is focused through the lens situated in the centre of the blue or brown part of the eye is somewhat similar to the way that the image is focused by the lens of a camera. Instead of the film which you have placed in your camera, nature has provided a film, called the retina, at the back of the eyeball, which receives impressions of objects. You do not need to go into a dark room to develop these impressions into a picture, because it is now really a part of you.

So delicate is this instrument—the eye, that we must not strain it by reading at dusk or at any other time in a poor light, nor should we read in joggling cars.

The muscles which control the eyes tire in just the same way as do other muscles of the body. Reading for a long time causes the eyes to be strained; it is well, therefore, to raise the eyes once in a while and look at a distant object to rest them. If the light comes from a window in front, the white page of the book will reflect the light into the eyes, and this glare is injurious. The proper position for reading is to sit with the back to the

light, thus allowing the rays of light to fall over the shoulder upon the book. The light should fall over the left shoulder of a pupil when writing, so that the hand will not form a shadow which would interfere with the writing. Small, fine, or blurred print also strains the muscles of the eyes. One should never read when the eyes feel tired.

It is important for you to use your own towel in drying the eyes, so that you may avoid any chance of carrying germs to them which may have been left on the towel by somebody with eye disease. Any injury or disease of the eye should be attended to by the doctor immediately.

Some of you may need glasses to correct your vision. The glasses do this by focusing the rays properly upon the retina, in much the same way as one would move a camera nearer or farther away from an object to get it into focus and so secure a good photograph.

Some people's eyes do not focus properly, and for that reason they get a blurred picture of the object they are looking at, just as a camera takes a blurred picture when out of focus. The muscles of the eye attempt to overcome this defect, and the strain caused by their efforts in doing so is one of the common causes of headache and other ailments.

Do you not see clearly? Do you hold your book a long distance in front of you in order to read, or do you bring your book quite close to your eyes? Do figures on the black-board seem blurred or indistinct? If so your eyes need attention. If your eyes often smart or become tired, or if your head begins to ache after reading

O E C L T D

T D F N P B O

D F E C L N P B

Fig. 42.—Letters for testing eyesight.

a short time, you should tell your parents. They should consult a doctor who will be able to advise you whether you need glasses.

If glasses are needed, great care should be taken to have the eyes carefully tested, so that the glasses may suit the eyes perfectly. The least error in the glasses will cause further trouble.

A TEST FOR EYESIGHT

You should be able to read the top line of the large letters on the preceding page in a good light at a distance of thirty feet; those in the middle line at twenty feet, and the lowest line at fifteen feet. If you are not able to see them clearly, you should consult your physician about your eyesight.

With proper glasses we obtain a correct focus and a clear picture, thus relieving the eyes of strain. The glasses may need to be worn only for reading, or for fine work, and their use may perhaps be discontinued in time. Many pupils have been thought to be very stupid, whereas the real trouble was that they had poor eyesight and could not see clearly what was written on the black-board.

If our eyes give any indication of weakness, they should receive proper attention at once. We can not appreciate too highly our marvellous sense of sight.

CHAPTER XV

CHEERFULNESS

"Health and Cheerfulness mutually beget each other."
Addison

IMAGINE that some of you are setting out for a day's tramp in the country or on a fishing expedition, and just as you are starting your dog comes bounding after you. Perhaps one of the boys says, "Let's leave the dog behind," and you all agree. The dog knows that you are talking about him, and when you say, "Go

FIG. 43.—Sport.

home, Sport," his friskiness vanishes. His ears droop, his tail goes down, and as you start off he gazes after you longingly. At such a moment not even a bone would restore his high spirits.

But if one of the boys, taking pity on him, says, "Let's take him along," and you call, "Here, Sport,

come on, old boy," how does it affect him? Immediately he is wild with delight. His ears go up, and his tail wags furiously. He barks and yelps and scampers around you joyously.

And it is very much like that with boys and girls. They do not show their feelings in the same way, but happiness and sadness have as marked an effect upon them as upon the dog.

Worry and fear have a harmful effect upon our nerves and bodies. At a sudden fright the heart beats more quickly, the limbs tremble, and the face becomes pale. A fright will even cause the mouth to become dry—that is, it will lessen the flow of those juices so necessary for the digestion of food, and a long period of worry, fear, and fretting will tend to weaken our whole physical condition.

Cheerfulness, on the other hand, does much to promote good health. Enthusiasm in our work and play will help to strengthen our muscles and will give us a hearty appetite; and cheerfulness at the dinner table will increase our enjoyment of the meal, and so will stimulate the flow of all digestive fluids.

There is no better physician than Dr. Merryman. The medicine he gives us to take is the pleasantest in the world.

Some people may say that they cannot help their feelings. This is only partly true. We can at least regulate our actions and to a certain extent our thoughts, and both thoughts and actions greatly influence feelings. Good actions and cheerful thoughts are accom-

panied by pleasant feelings. We should try to get rid of trouble and worry by some activity, whether work or play. This will occupy the mind, banish gloomy ideas, and promote cheerfulness and health.

In "*The Adventures of Tom Sawyer*" we are told how on one occasion "a new and powerful interest bore down Tom's troubles and drove them out of his mind." The special interest in Tom's case was only "a valued novelty in whistling, which he had just acquired from a negro," but his interest in learning to whistle in a special way was enough to banish his troubles.

We have it entirely in our own hands to cultivate a bright and cheerful disposition that will make the world a pleasanter place both for ourselves and others, or to cultivate a gloomy and morose disposition that will make things disagreeable for everybody. Taking a keen interest in our work and doing it well, associating with good companions, reading good books, and living a healthful outdoor life will make us more cheerful. Persistently looking on the bright and hopeful side of things will develop a habit of cheerfulness. Some one has very aptly expressed this idea in this way:

"The inner side of every cloud
Is always bright and shining;
I therefore turn my clouds about,
And always wear them inside out
To show the silver lining."

Nothing is so contagious as cheerfulness. If we have it, others will "catch" it from us. It therefore benefits not only ourselves, but also everybody with whom we come in contact. Do you know the song the Canadian

soldiers sang when they went to the war in Europe? They knew that cheerfulness can be cultivated and that it is contagious. And so they sang:

> "What's the use of worrying?
> It never was worth while.
> So pack up your troubles in your old kit bag,
> And smile, smile, smile."

There is no doubt that many of our soldiers, by persistently thinking cheerful thoughts and refusing to look on the dark side of things, communicated their cheerfulness to their companions. So they made possible the endurance of terrible discomforts and hardships and the performance of incredible deeds of daring and heroism with the most wonderful spirit of cheerfulness and optimism.

CHAPTER XVI

THE KEY TO HEALTH

JUST as there is no royal road to learning, so there is no magic key which will open the Temple of Health. The best we can do is to rely upon good habits, in order that we may acquire and maintain good health.

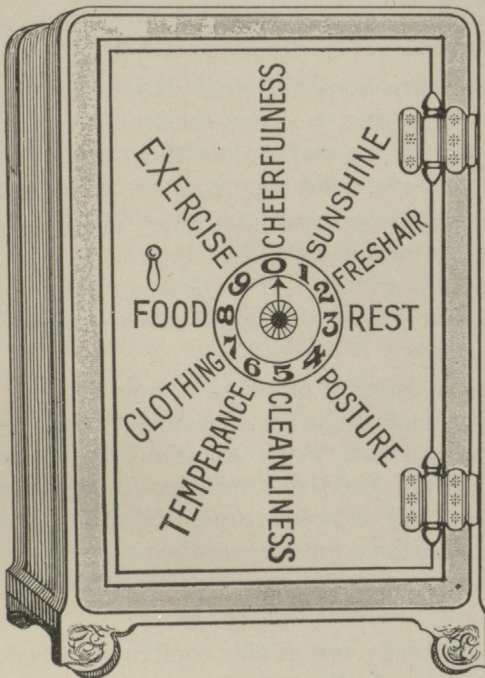

FIG. 44.—A modern safe.

People who are fortunate enough to possess Victory bonds, insurance policies, mortgages, or other valuable papers, usually keep them in a safe. The old-fashioned

safe was opened with a big iron key; the modern safe has a combination lock, which has a steel knob with various numbers marked around it, and also a little arrow, or indicator, pointing to these numbers, which is used instead of a key. When one wishes to unlock the safe he turns this knob around, backwards and forwards, so that the indicator points to the different numbers placed around the knob. When the knob has been turned correctly, there is heard a little click, and the lock unfastens.

Every safe has a special combination of numbers to be used in unlocking it. This combination of numbers is known only to the makers and the owner of the safe, otherwise anybody could open it.

Now health is more valuable than Victory bonds or mortgages, and to open the door leading to good health no ordinary key will do. It requires a special combination to unlock it, and this combination every boy and girl should know.

Instead of a series of numbers such as we have on the iron safe, we shall use a list of words. These are Good Food, Exercise, Rest, Fresh Air, Sunlight, Cleanliness, Correct Posture, Suitable Clothing, Temperance, and Cheerfulness. All of these are essential to this wonderful combination, and we must make the proper use of them if we desire to open the door leading to the Temple of Health.

In time the daily use of this combination becomes a habit, and we gradually make it a part of our everyday life, so that health habits at last become second nature.

While health habits are most desirable, we need never become slaves to them. If we did we should often be in a bad plight, for they frequently have to be varied

or discontinued. For instance, if some of us were fortunate enough to be given a trip to the West, how should we be able to have sufficient out-of-door exercise while travelling four or five days on the train? If we were taking a long canoe trip in the North country, how could we get fresh eggs, milk, and vegetables? Or if we went to an evening party, a concert, or a meeting which kept us from getting to bed at our usual hour, how should we obtain our needed rest? Or if an accident occurred to one of our family or some sorrow entered our home, how could we whistle and smile and keep cheerful?

These are but a few examples of the many things which may at times interrupt our regular daily course of living. But the general rules for our guidance in healthful living are not made of cast-iron, and a healthy person will take no harm from occasional interruptions and changes. In fact, that is a good point about health habits. They make us healthy and strong, but they can be occasionally discontinued without making us ill.

There are other habits which act like rust and prevent the opening of the lock. These are the habits of drinking, smoking, and the taking of drugs. They are habits which are never needed for the health combination of which we have been speaking, for they are injurious. They corrode and spoil the health combination, making it difficult to use, in fact almost useless.

CHAPTER XVII

ALCOHOL

The term alcohol is generally applied to a liquid which is found in all alcoholic drinks, such as wine, beer, whiskey, brandy, and gin, and is produced by the fermenting action of yeast upon sugar. The alcohol in wine, for instance, is produced by the fermentation of the sugar in the juice of the grape. The alcohol in beer, again, is produced by the fermentation of malt-sugar. This malt-sugar is produced in the process of brewing, by the fermentation of the starch in the barley grain. Whiskey, brandy, gin, and other spirits are obtained by the process of distillation. (When a fermented liquor is boiled, the alcohol evaporates more readily than the water, because it boils at a lower temperature. When this vapour is condensed in a still, it is called distilled spirits.) Besides these spirits and beverages, many of the widely-advertised patent medicines contain a large percentage of alcohol.

The first effect of drinking alcohol is to lessen one's self-control. Many think that alcohol is a stimulant or something which is strengthening, because a man under its influence becomes more lively, talkative, and boisterous. This is due to its effects upon the nerves which control thought, speech, and actions. Instead of stimulating them, however, it depresses or weakens them, and they lose their power of control. The nerves, which have been acting as brakes as it were, are not working properly. A person under the influence of alcohol becomes dangerous, just as a speeding motor car is dangerous when its brakes are out of repair and fail to hold the car.

Even small quantities of alcohol cause a man to lose the fine co-ordination of all his movements. When he has taken more, his eyes deceive him, for he does not see straight. In fact he often sees double; his legs are unsteady, and he has a staggering gait; his hands shake, his voice becomes thick and his words mumbling. If he takes still more, he will become intoxicated or drunk, and finally collapse into physical and mental helplessness.

Thus we see that alcohol has a powerful and harmful effect upon a man's body and upon his mind. Upon a boy or a girl it would have a more serious effect. It is especially poisonous to them. Most drugs have to be given to children in much smaller doses than to men or women. The effect of drugs in very small doses upon a child is as great as the effect of much larger doses upon a fully grown person. You have only to look at the directions upon many bottles of medicine to see that the dose prescribed for children is much smaller than it is for men or women.

Fortunately, Canadian children seldom drink wine or beer; but in some of the European countries it is different. One of the evil results is that even in small quantities it dulls their minds. Dr. Hercod, an Austrian physician, has shown that "out of 591 school children in Vienna, the best certificates for scholarship were gained by those who took no alcoholic drinks; the results were not so satisfying in the cases of those who occasionally did so; but the poorest scholars of all were those who took wine or beer two or three times a day."

Alcohol has a bad effect both upon the muscular work and upon the mental work. This has been shown by workers in the Boston Laboratory of the Carnegie Institute who have studied the effects of alcohol upon the

efficiency of trained typists. Within the first two hours after taking small doses of alcohol, there was found to be a decrease in the amount of work done by them, owing to the depressing action of alcohol. Muscular movements were found to be slower and very inaccurate, and the mind was less alert. The number of errors made by them increased, and their writing was less legible. In other words, these typists, owing to the action of alcohol, had become less efficient. Poor as their work was, they themselves believed that they had done very well, for their senses had been blunted. Lord D'Abernon, of the British Medical Research Council, says that "alcohol gives the drinker a false impression of having done his work with unusual speed and success, whereas impartial examination shows that both accuracy and regularity are not up to the standard."

Many great corporations, transportation companies, and other employers of labour, knowing from experience that alcohol is a hindrance to a man's work, will not employ men who drink. Alcohol impairs the memory, and many mistakes and errors arise from its use. Even the moderate use of it impairs one's judgment, will power, and vigilance. These are effects which no engine driver, motor driver, or sea captain can afford to risk. Passengers would not board a train if they knew the engineer was under the influence of liquor, nor would they sail on a ship if they knew the captain was not sober. So dangerous would such a situation be for all on shipboard, that a sea captain, while on duty, does not drink alcohol at all.

Those who value "Safety First," either for themselves or for others, should abstain from alcohol in any form. An inquiry has been carried out for the International

Labour Office of the League of Nations as to the relation of alcohol to industrial accidents, and the conclusion is that—"It would be a conservative estimate to say that the industrial accident risk is about three times as high among drinkers as among men in general." That is to say, more accidents happen to men who drink than to abstainers.

While the bad effect upon one's work is more important than its effect upon athletics, yet games and sports make up such a large part of a boy's life that the effect of alcohol upon athletes should be considered. No captain of a baseball, hockey, football, or any other athletic team would use a player in the slightest degree under the influence of alcohol, for successful team play would then be impossible. Alcohol reduces the strength, the speed, and the staying powers of any athlete, as well as the precision of all his movements.

To hold a high position in athletics, one must avoid alcohol. Many a champion athlete has lost his title through the use of it, for it has proved to be stronger than any other opponents.

Much that has been written upon the evil effects of alcohol is criticised, because it refers to the abuse of alcohol instead of what is called the moderate use of it. But unfortunately it is very hard to draw the line, for the moderate drinker tends gradually to become immoderate, owing to the insidious effects of alcohol upon his will power and self-control.

The immoderate or excessive use of alcohol is harmful, as all the world knows. "What is excessive?" is the question. The man who drinks alcoholic liquor usually claims to be a moderate drinker, but, as the effect of drinking is to impair the judgment in this regard, his

evidence is not always as sound as the evidence of the man who does not drink. "The best judge, however, is the qualified and scientific observer."

Physicians are generally agreed as to the dangers of alcohol. A recent issue of the Canadian Medical Association Journal, in discussing alcohol says: "The opinion of the medical profession on the action of alcohol and on its value as a beverage, a food, and a medical agent has varied greatly from age to age. During the middle part of last century it was regarded not only as a valuable food, but also, under conditions of exhaustion and weakness, as a heart stimulant. This opinion, owing to the results of careful investigation by chemists and physiologists, has during recent years been greatly modified, if not altogether reversed."

Alcohol is not stored up in the body as natural foods are, and so it is not a body builder. While all the food constituents, such as proteins, carbohydrates, fats, and certain mineral substances are necessary for the body, alcohol is not essential at all. In fact so far as the building up of our body goes, there is more real food value in a glass of milk than there is in a barrel of alcohol.

The dangers of using alcohol are many. One of these is that it is a frequent cause of indigestion, headache, nervousness, and weakness. We also know that its use is commonly connected with the appearance of disease in the stomach, the liver, the brain, and the nervous system. According to Professor L. F. Barker: "Chronic poisoning from alcohol may be very injurious to the nervous and mental functions, especially in persons predisposed to nervous breakdown." It has been estimated that more than twenty per cent of the males

admitted to asylums for the insane owe their mental disorders to the abuse of alcohol.

We have been discussing the direct effect of alcohol. It is also the indirect cause of certain diseases. The habitual drinker spends too much of his earnings upon drink; this habit leads to his being frequently out of work, and so to poverty. The results are bad housing conditions, poor and insufficient food, and broken rest for himself and for his family. These cause much ill-health and favour the spread of disease. For example, tuberculosis, which takes off so many young men and women just when they should be at their best, thrives among the under-nourished and ill-clothed, for they have not the strength to resist it. Their poverty forces them to live in overcrowded houses, and the overcrowding aids in the spread of disease. Other diseases likewise thrive under such conditions, but enough has been said to show how alcohol indirectly helps the spread of disease.

As a medicine alcohol has its uses. For instance, when applied to the skin it may be helpful for the relief of inflammation and pain, and it is useful also as an antiseptic. It may also be useful in certain cases of illness when properly prescribed. But according to the findings of the British Medical Research Council: "Alcohol is a depressant, it definitely weakens the powers of resistance to disease, and even if taken moderately, is not favourable to long life."

Explorers of the Polar regions are well aware of this, for they avoid taking with them men who use alcohol. They do not consider such men capable of facing the hardships, the bitter cold, the fatigue, and the privations so frequently encountered there. The reason for this is that alcohol disturbs the delicate mechanism

which regulates the heat of the body. Especially is this shown in extremely cold weather. Let us suppose that, when you light a fire in the furnace on a very cold day, somebody should open all the windows in the house. The heat in such a house would then be lost, and it would be colder than it was before.

Alcohol dilates the blood-vessels of the skin, thus permitting heat to escape from the surface of the body. This gives one the sensation of warmth, but in reality the body has lost heat, and the person is likely to take cold more easily.

The natural heat-producing foods, such as fats and carbohydrates, do not disturb the heat-regulating mechanism of the body, and that is why the Eskimo lad who lives on fat can stand the cold. Bread and butter and chocolate bars would also help to keep him warm, but such luxuries seldom fall to his lot.

Insurance companies on this continent have found that the use of alcohol tends to shorten life, and therefore they do not care to insure those who drink. Dr. Eugene Fisk of New York, in an address at Toronto, referring to insurance, said that: "One of the studies on life insurance risks, covering 286,000 lives, showed that there was an increased death rate among moderate users of alcohol as a beverage, of nineteen per cent, and an increased death rate among daily users of spirits (which are stronger than wines and beers) of sixty-six per cent." There is no reason to doubt the testimony of scientists and life insurance experiences, that the so-called moderate use of alcohol shortens life.

British insurance companies also favour the total abstainer; they find that he has a better chance for long life than those who drink.

The evil effects of alcohol are not limited to those who use it. It has been found that these evil effects have been transmitted to the children. Professor Laitinen, of Finland, for seven years studied the results of alcohol upon a whole community in that country, and found that the children of the non-drinkers were taller and weighed more at the same age and were more free from disease than the children of the moderate drinkers.

Similar studies have been made in different parts of the world, and the conclusion has been the same, namely, that the evil effects have been transmitted to the children, so that they tend to become less fit.

Since all agree that the excessive use of alcohol is the cause of much crime, disease, and misery, and since the effect of even a small quantity is insidious in lessening self-control and will power, it is surely foolish in the extreme to have anything to do with alcohol.

Health and happiness have been so often shattered by its use that the best thing one can do with all alcoholic drinks is to leave them alone.

The safest and most healthful drink of all is water. Our bodies are composed two-thirds of water. Its loss through perspiration, through the breath, and in other ways, is replaced by the water we drink and by that contained in our food. There is no alcohol in the composition of our bodies, and we have no need for it. The desire which some have for alcohol is not a natural thirst, but an acquired one growing out of its use. This desire may with some become a craving or unnatural thirst which no amount of alcohol can ever satisfy.

Water quenches our thirst and satisfies the body's needs. Alcohol does neither. The best drink then for all is water.

CHAPTER XVIII

TOBACCO

TOBACCO and its smoke contain powerful poisons, and therefore its use, especially by the young, is harmful. One of these poisons is nicotine, and it is found in all kinds of tobacco.

The most frequent use of tobacco by young people is in the smoking of cigarettes. When a boy smokes for the first time, he usually becomes violently ill, thus proving that his body has no need for the use of the tobacco and that harm is done. By persistence the boy may force himself to endure tobacco, and then he gradually acquires the habit of smoking, which develops into a craving. He then smokes more and more frequently and becomes restless without it.

The practice of inhaling tobacco smoke by drawing it down into the lungs is especially harmful. The smoke then reaches a far greater surface than when smoking in the ordinary way, and much more of its poison is absorbed into the system. The smoke itself also irritates and harms the delicate lining of the air cells in the lungs.

The chewing of tobacco is more harmful than smoking, for more of the poisons are absorbed, and in addition the habit is a filthy one.

Many a boy who smokes shows signs of listlessness in his studies. This is due to the effect which tobacco has upon his brain and nerves. He cannot keep his mind on his work, and he fails to grasp what he is reading. He forgets things easily, loses interest in his work, and steadily goes down in his classes.

In the same way he becomes less interested in games. Moreover, hard play tires him. Now one of the most important things for success in games is staying power, and one cannot have that if his "wind," as it is called, is not good. One is "winded" or out of breath when the heart fails to pump the blood into the lungs fast enough for them to get rid of the carbon dioxide and to take in enough oxygen to keep up the breath supply. Since it weakens the force of the heart beat, smoking is bad for one's "wind." That is why an athlete in training or a boy playing on any team should not smoke. If he does smoke, he soon gets short of breath and frequently has a pain in the side. Then he has to drop out of the game. If a boy's heart and lungs are sound, he soon gets his "second wind" as it is called, and then he can begin playing again. If he persists in smoking, however, especially if he inhales cigarette smoke, it affects his heart, so that he gets out of breath often and after but slight exertion, and it takes much longer for him to recover. It is easy to see how such a boy is of very little use to any team.

It is not long before the smoker's appetite also begins to fail. His digestion suffers. His head often aches, and in time his general health is impaired. Sometimes his heart beats irregularly, and this causes distress. A boy smoker, with his stained fingers, his pale face, and general listless manner, is far from being at his best. But most of these troubles will disappear if the cause is removed. That is to say, the boy will improve if he stops smoking.

There are other bad results, however, which are not so easily remedied. One of these is a sore throat.

This is caused by the irritating smoke from cigarettes, which inflames both the vocal cords and the back of the throat. Many a good singer has ruined his voice by smoking.

In addition to all these troubles, smoking may injure the nerves of the eye, and so seriously affect the eyesight.

Since the use of tobacco is a handicap or hindrance to one in his work and in his play, it is best for those to avoid it who desire really to enjoy life and to make the most of themselves. Many are born with handicaps, such as poor eyesight, lameness, and other defects which hinder them all through life. Others may acquire some handicap through illness or through accident for which they are not to blame. But those who acquire a handicap through smoking do so as a result of their own folly.

CHAPTER XIX

HABIT FORMING DRUGS

NARCOTICS are drugs which in moderate doses relieve pain and produce sleep, but in larger doses produce stupor and unconsciousness. The most common ones are opium, morphine (which is obtained from opium), and cocaine.

Opium is prepared from the juice of the opium poppy —a plant originally found in Asia Minor but now widely cultivated in Eastern countries. Cocaine is a drug prepared from the leaves of the coca-plant (not to be confused with cocoa) grown in South America. These drugs are very useful as medicines in certain cases of illness, but they should never be taken except upon a doctor's advice.

Some patent medicines contain narcotics, and these may have been responsible for causing persons to become slaves of a drug. Those taking such medicines may acquire a taste for the drug, and ultimately the taste may become a craving. Some of the worthless catarrh remedies contain cocaine. Certain cough medicines, soothing syrups, and so-called consumption cures contain opium and morphine; and many advertised tonics and blood purifiers contain alcohol in large proportions. Fortunately the amount of narcotics in patent medicines is now reduced, and their sale is restricted by the Federal Department of Health.

When ill we should consult our family doctor and avoid quackery and patent medicines.

Every one has a natural appetite for food and a natural thirst for water, but those who take any of these drugs soon develop an unnatural appetite or craving

for them. In time the drug has to be taken in increasing doses to produce the required effects; and the person taking it becomes an addict or slave to it. Then his health suffers, his mind becomes affected, and his character and morals deteriorate. He is in complete bondage to the drug. That is why the unfortunate drug addict has been called a "dope fiend." As said before, the drug habit is very hard to break, and the withdrawal of the drug in an attempt to break the habit often causes much misery and distress. But, as in the case of other bad habits, the cure is to cease altogether to use the drug.

We are told that the number of drug addicts in Canada has been increasing, therefore all good Canadians must guard against this evil. While boys and girls of school age are not likely to trifle with such drugs, yet it is well to be warned of their terrible dangers before it is too late.

II.—PREVENTION OF DISEASE

CHAPTER I

PASTEUR AND LISTER

In the preceding pages of this book we have been told how the most wonderfully constructed machine in the world—the body—should be cared for. We have learned that food and sleep, work and play, fresh air and sunlight, and many other things are important to enable the body to grow in health and in strength.

Unfortunately, however, there is a great enemy in our midst, called disease. This enemy has many forms, and man has been forced throughout the centuries to learn by his own experience how to attack and conquer it most effectively. This struggle has been a long one. Within recent times man has been able by careful study to discover some of the causes of disease; and by intelligent application of this knowledge he has found a cure for certain diseases.

What is much more important, however, than finding a cure, is the discovery that many diseases which formerly took an enormous toll of lives and caused great suffering can now be prevented.

Now boys and girls should be happy, and they should not worry about sickness at all. They should follow all the rules which tend to develop good health, but they should know that, even though they carefully carry out these rules of health, healthy bodies alone will not protect them from certain diseases. It is really just as important to know how to prevent these diseases as it is to know how to make the body strong and healthy.

For that reason it is necessary to learn something of the causes of disease. Without this knowledge it is impossible to understand how it may be prevented.

Many years ago men thought that sickness was caused by evil spirits, and even to-day uncivilized races hold to this belief. All sorts of schemes were tried to frighten away these evil spirits, such as the beating of drums and the observing of other queer practices which seem to us very foolish. *David Thompson*, the explorer, tells a story of our Canadian North-West Indians:

"In the following October six men and myself were fitted out with a small assortment of goods, to find the Peeagan Indians and winter with them; to induce them to hunt for furs and make dried provisions; to get as many as possible to come to the house to trade; and to trade the furs of those that would not come. Each of us had a horse, and some had two furnished by ourselves.

"Our road lay through a fine country, with slight undulations of ground too low to be called hills, everywhere clothed with fine short grass and hummocks, or islands of wood almost wholly of aspen and small but straight growth. About the tenth day we came to the "One Pine." This had been a fine stately tree of two fathoms girth, growing among a patch of aspens, and being all alone, without any other pines for more than a hundred miles, had been regarded with superstitious reverence.

"When the smallpox came, a few tents of Peeagans were camping near it. In the distress of this sickness, the master of one of the tents applied his prayers to it, to save the lives of himself and family, burned sweet grass, and offered upon its roots three

horses to be at its service—all he had; the next day, the furniture of his horses with his bow and quiver of arrows; and the third morning, having nothing more, a bowl of water. The disease was now on himself, and he had to lie down. Of his large family only himself, one of his wives, and a boy survived.

"As soon as he acquired strength, he took his horses and all his other offerings from the "Pine Tree," then, putting his little axe in his belt, he ascended the Pine Tree to about two-thirds of its height, and there cut

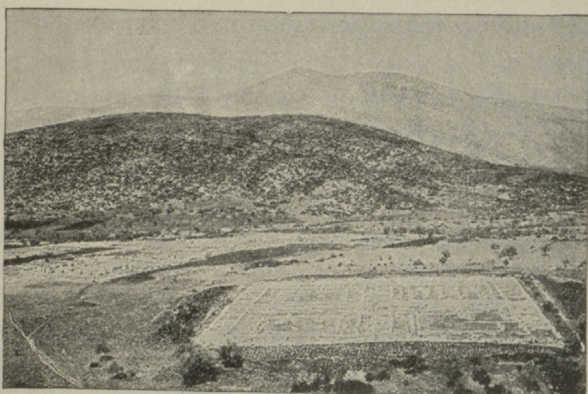

FIG. 45.—Ruins of Greek Health Temple. *Courtesy of Yale University Press.*

it off, out of revenge for not having saved his family. When we passed, the branches were withered, and the tree going to decay."

The Greeks, who at one time were the most learned and cultured nation in the world, sought to keep their bodies strong and graceful by exercise and by being moderate in all their activities. For the healing of the body and the mind great Health Temples were built on

the hillside or on the edge of a forest where sunlight, fresh water, and pure air were found, and where the beauty and quiet of nature helped to restore the sick to health. The Greeks, unlike uncivilized races, did not regard disease as being caused by evil spirits which must be frightened away by noise. They looked upon disease as a part of nature, like the growth of trees, which should be observed and studied as a natural thing and not as supernatural. This great step in advance was really the foundation of medicine, because without careful observation we should not be able to treat disease any more effectively than the Indian in Thompson's story.

Luckily for us some of the Greek writings have been preserved, and from these we may learn, not only how carefully the Greek physicians observed their patients, but also that the diseases in the time of the Greeks were the same as those of to-day.

But of the true causes of disease they had not the faintest idea. Indeed, they did not even understand what the body was composed of. They thought that the flesh and blood of the body were made up of equal parts of fire, earth, water, and air, and that the bones were made up of one-half fire, one-fourth earth, and one-fourth water. Though we think now that these ideas were very foolish, yet the important thing to remember is that they were thinking of these things so long ago.

For centuries after the time of the Greeks little knowledge about disease was acquired. Indeed, except in such centres as Salerno, about which we read in the beginning of this book, learning was at a low ebb. It was not until the sixteenth century that men began to find out how the body was constructed. This study is called Anatomy. Anatomy was the first step towards

finding out how the various parts of the body, such as muscles, heart, and lungs, work together to keep us alive.

The study of the action of different parts of the body is called Physiology. William Harvey, in 1682, wrote a small book describing the circulation of the blood. He showed how the heart pumps blood through the body, and how the blood comes back again to the heart to be pumped through the lungs. Thus by careful observation Harvey laid the foundation of Physiology. The knowledge of how the body is constructed and how the various parts do their work is necessary for the study of disease, because disease really means that the body is not working as it does when we are healthy.

About this time men were working away in different lands and slowly finding out new things about nature. While engaged in this quest they made two very important discoveries. These were the telescope and the microscope.

These two instruments are made of delicately ground magnifying lenses. We have all seen a burning glass, and know that by holding it in a certain way we can make the sun's rays come to a point, and that if we hold it there long enough, the heat produced will kindle paper or dry wood. If we look at the page of a book through such a glass, the letters appear much larger, and we speak of them as being magnified. If we look at the sky on a clear night, we may see many little points of light—the stars. If the moon is full, we can see the "man in the moon." But if the eye is aided by a telescope, there are many more stars visible, and the face of the man in the moon is seen to be made up of high mountains and the shadows they cast. If the

magnifying lenses are very perfectly made, as in a good microscope, the objects we look at appear to be one thousand times larger than they really are, and we may thus see things that the eye alone could never detect.

The first useful microscope was made by a Dutchman—Leeuwenhoek (*Loe-ven-hook*)—in 1673. He saw with it small living things which we call germs, and this discovery opened up a new world to learn about. For

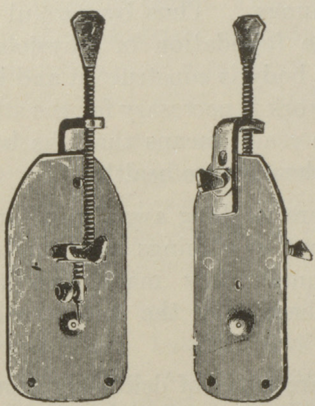

FIG. 46.—Leeuwenhoek's Microscope (1673) —*From Carpenter "The Microscope and its Revelation." J. & A. Churchill, publishers, London, England.*

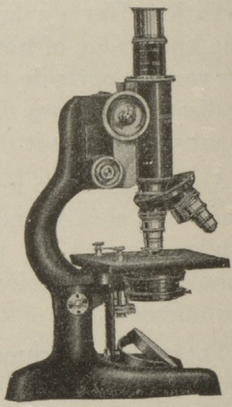

FIG. 47.—A Modern Microscope.

two hundred years it was not understood how very important these germs are to us. During the last century very great advances have been made in regard to our knowledge of the causes of disease, advances which have been more important than all those made during the centuries before this time.

It is to Pasteur, the great Frenchman, that we owe an incalculable debt of gratitude for pointing out the path which has led to man's mastery over certain

diseases. This path we are still pursuing successfully in our conquest of many other diseases.

Louis Pasteur was born at Dôle, December 27th, 1822. His father had been a sergeant-major in Napoleon's army, but was a tanner at the time of the birth of Louis. His mother was a gardener's daughter. As a lad Louis applied himself diligently to his books, and finally became a teacher himself. He was most interested in chemistry, and devoted much time to the study of how the little round cells called yeast, which he saw with his microscope, changed the sugar contained in the solution in which they were growing into alcohol. He also studied how certain tiny specks of living matter, when put into milk, caused it to become sour. When these were not growing in the milk, it remained sweet. These tiny living particles were so small that a microscope had to be used to see them. The names we sometimes give to these are germs, bacteria, micro-organisms, and microbes. These names really mean that they are very small, and that they are living. Pasteur discovered then that the milk became sour because certain germs were growing in it. This seems a very simple discovery, but it was quite new to the world a little less than one hundred years ago.

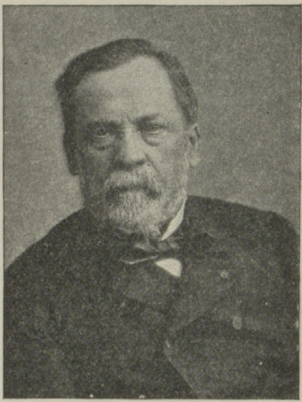

Fig. 48.—Louis Pasteur.

You may wonder why this discovery was of so very great importance. Pasteur thought that if, as he had shown, certain germs could cause milk to become sour, possibly other germs could cause disease. This he set out to prove. As a result of his studies, he was able to show how to control a disease of silk-worms which had almost ruined the silk industry in France. He also showed how a disease of sheep, which by its fatal results cost the country a great deal of money, was caused by

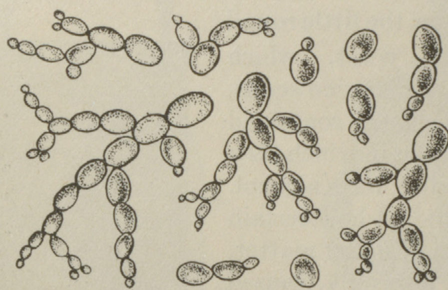

Fig. 49.—Yeast cells as seen under a microscope. Tiny plants like these make our bread light.

certain germs growing in the animals' bodies; and by his brilliant studies he found a way of preventing sheep from getting this malady. He studied with equal success a disease of chickens. Thus we see that Pasteur's work was largely devoted to the cause of disease in animals. It was, however, not only his studies of animal disease, but the new principles of prevention which Pasteur gave to the world, which make his name immortal.

Every one should know of the discoveries Pasteur made in his studies of hydrophobia or rabies--the name of the disease as applied to mad dogs, wolves, and other

animals. When a dog becomes mad, we speak of him as suffering from hydrophobia. A dog with this disease is no longer the quiet, faithful animal he formerly was, but becomes savage and may bite even his master.

On July 6th, 1885, a little Alsatian lad, Joseph Meister, came with his mother to see Pasteur. He had been bitten in fourteen places, two days before, by a mad dog. The boy would surely get hydrophobia, for it was known that the saliva of mad dogs carried the living poison of the disease. Pasteur was greatly moved at the suffering of the little lad. What could he do? No human being had yet been treated by him, but so successful had his work with animals been that Pasteur finally consented to apply his method of preventing rabies in an attempt to save the life of little Joseph. After many nights of anxious watching Pasteur was finally rewarded, for the little boy remained well and was sent home with his grateful and happy mother.

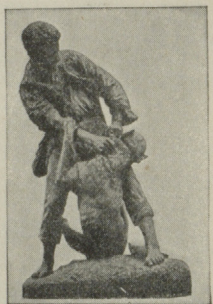

FIG. 50.—Statue in front of the Pasteur Institute to commemorate Pasteur's discovery of the treatment for the prevention of rabies.

The second boy to be treated by Pasteur was a shepherd lad of fourteen, who in order to save his comrades, bravely attacked, bare-handed, a mad dog. He received severe wounds in his struggle with the beast, but his life, like that of little Joseph, was saved.

The fame of Pasteur spread throughout Europe, and many people who had been bitten by mad dogs came, even from far off Russia, to obtain the wonderful treatment. Poor people as well as princes contributed to a

large fund for the purpose of building a Pasteur Institute where treatment for the prevention of hydrophobia might be obtained. Now in every civilized part of the world the Pasteur treatment can be carried out whenever a person is bitten by a mad dog.

When he grew older, the brave shepherd boy became the door-keeper of the Pasteur Institute in Paris, and for years told to the visitors from many lands of his gratitude to the great Pasteur.

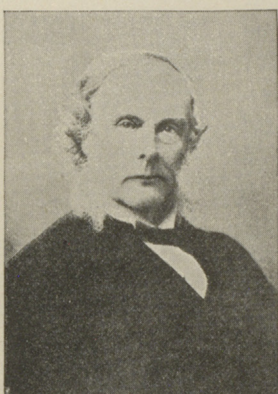
FIG. 51.—Joseph Lister. *Courtesy of Canadian Medical Association Journal.*

At this time, also, Joseph Lister, an English physician, had been working for years to find out why some wounds did not heal. The work of Pasteur gave him a clue to his problem. If tiny, microscopic, living germs cause milk to become sour, then, thought he, other kinds of living germs, by their growth and the poison they produce, can prevent wounds from healing. After many years of patient work he discovered that this was what really happened. He was able to show that living germs, which were harmful and prevented wounds from healing properly, often came from the instruments and the hands of the surgeon. He found that if sufficient care were taken to prevent harmful germs from entering the wound, it would heal quickly and without danger of causing blood poisoning. Before the time of Lister so many people died of blood poisoning that often the surgeons feared to operate even to relieve suffering.

But to-day, because of Lister's patient and careful work in showing how germs may be kept from getting into wounds, our surgeons may perform many life-saving operations which were not thought possible before his time. Joseph Lister has done more to save life and relieve pain than any other man in the history of our race.

CHAPTER II

GERMS—OUR FRIENDS AND ENEMIES

Every person should understand clearly what bacteria or germs are and the importance of what they do in the world about us.

Indeed we shall learn that without bacteria and their first cousins—moulds, mushrooms, toadstools, and puff-balls—our earth would soon become a lifeless desert.

If we were asked to name a plant, probably the first ones we should think of would be those which produce flowers which every one likes, such as violets, roses, or daffodils. Some of us might think of oak, or pine, or maple trees. It is not likely, however, that any of us would mention bacteria, mushrooms, blue-mould—which we sometime see on food,—or yeast, which is used to make our bread. These are plants too. When we study them, we find that they are interesting and very important to us. Let us see in what way they differ from the trees and plants about us.

One difference is that they are smaller. Indeed by far the greater number of them, bacteria, for example, cannot be seen without the aid of a powerful microscope. Just as are our bodies, so larger plants are made up of tiny cells, some of which form the leaves, the channels

for the sap to flow through, the roots, and all other parts of the plant. Bacteria, however, are formed of one single cell.

Another difference between these lowly forms of life and the higher forms is the kind of material they use as their food. In order to understand more clearly what this difference is, let us first learn something about a wonderful substance called carbon which all living things require in order to live and grow.

Carbon is so wonderful that it is almost like a magic substance. It has a great many different forms. The lead in our pencils, charcoal, soot, coal, and diamonds are each made up almost entirely of carbon. Things made by plants, such as wood, and leaves, and things that burn well, have a great deal of carbon in them. But even more strange, it may, like the magic cloak in the *Arabian Nights*, exist in a form we cannot see at all. This invisible form is the gas called carbon dioxide.

When a piece of wood is kindled, it is the carbon in it that burns, and in burning, this carbon uses oxygen from the air. Without oxygen things do not burn. The carbon joins with the oxygen and makes carbon dioxide which goes off into the air. You remember that we breathe out from our lungs carbon dioxide. This, too, is formed in the body by the slow flameless fire which uses oxygen just as does the wood. So we find that burning, whether slow or fast, means that carbon joins with oxygen to form carbon dioxide. When carbon and oxygen join they give off heat. The carbon itself is never destroyed. It is merely changed into another form. In nature nothing is really lost. Only change takes place.

Since we ourselves and all other animals must obtain a supply of carbon from our food, let us discover where we get it. For it we are dependent upon green plants. But do not some animals live on meat and not on green plants? That is true, but where do these animals in turn obtain their carbon? They obtain it from green plants. Let us take some examples. Suppose we eat a hen's egg for breakfast. The hen lives on grain and other things made by green plants which have a great deal of carbon in them. A timber wolf kills a deer in our north land; the deer lives on grass, leaves of trees, and other green food. Butter and cheese are dairy products made from milk. The cow which gives the milk lives on green plants. If you think of ever so many examples for yourself, you will find that in every case the animals are dependent for part of their food upon the products of green vegetation.

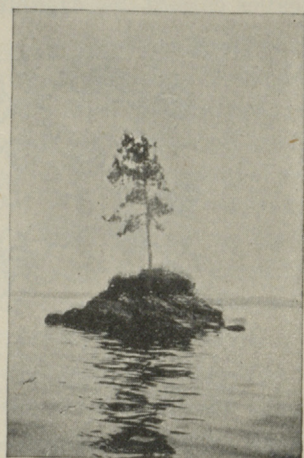

FIG. 52.—Trees are nourished mainly from the air.

But where do the green plants get their food? Most of you will probably answer: "From the earth, through their roots." This is true, but only a small part of their food is obtained in this way. Most of it comes from the air. Some of you may have seen a pine-tree growing in very little soil in the Georgian Bay region. How is it possible that the hard wood of a tree is formed out of air? Only a part of the air is used

by the tree, namely, the carbon which exists in a magic invisible form in the air as carbon dioxide. The tiny holes in the leaves of plants breathe in the carbon dioxide. The carbon part of the gas is held back in the leaves, and is used as food to make the plant grow wood, bark, leaves, sap, and nuts. The leaf of a plant is like a noiseless workshop where this wonderful process is carried on. People who have studied this process have found out that this work done by the leaves cannot be carried on without the aid of sun-

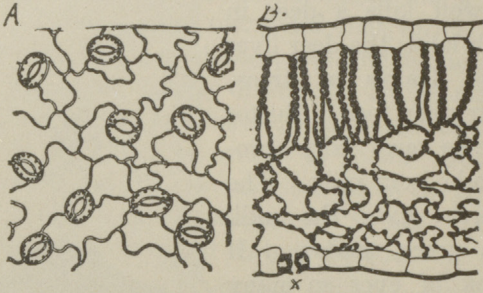

FIG. 53.—*A*. Surface of a leaf, note the little holes for breathing set in the cells which fit into one another like a jig-saw puzzle. *B*. Slice of a leaf, note the hole for breathing (x). The dark dots are the green colouring matter which uses sunlight and carbon dioxide. *From Brown's General Botany by permission of the publishers, Ginn and Company.*

light. They have discovered, too, that it is the green substance of plants that uses the sunlight to take out the carbon from the air and to turn it into wood, bark, leaves, sap, seeds and other parts of growing green things.

Moulds and bacteria, like green plants and all other living things, also require carbon as their food. However, they have no green substance in their bodies such as the green plants have, and thus cannot make use of the sunlight in order to obtain carbon from the carbon dioxide of the air. Where do they get the carbon? It is already prepared for them by the green plants, which

have carbon stored in their bodies in the form of leaves, fruit, sap, and wood. But it is not from the living plants, as a rule, that moulds and bacteria get their supply of carbon. It is from fallen leaves, dead trees, cut straw, withered grass, and things in nature no longer alive.

Perhaps you are now ready to answer the question—why are bacteria and moulds and fungi important to us? The reason is that these tiny creatures slowly use up, as their food, the dead things in nature.

This work of these tiny plants is known as decay or rot. The bacteria and moulds, in using the carbon of the dead things of nature as their food, turn the carbon into carbon dioxide. In other words, they give off carbon dioxide when they live and grow. You remember that man and animals do the same. The carbon set free by these creatures then goes off into the air as carbon dioxide. This is again ready for use by the green substance of plants, to be built up once more by the aid of sunlight into wood and other parts of the plant.

Other substances besides carbon dioxide are also set free when bacteria grow on the dead things of nature. These dissolve in the rain and are returned to the soil to be taken up by the roots of growing trees and plants. Thus, if it were not for these tiny plants and the work they do, our earth would soon be covered by a deep layer of dead things, the supply of carbon would be completely exhausted, and no green things could grow at all.

Let us review what changes this substance, carbon, may go through in nature, so that we may form a clear idea of what takes place. The plants with their green substance, aided by sunlight, take the carbon

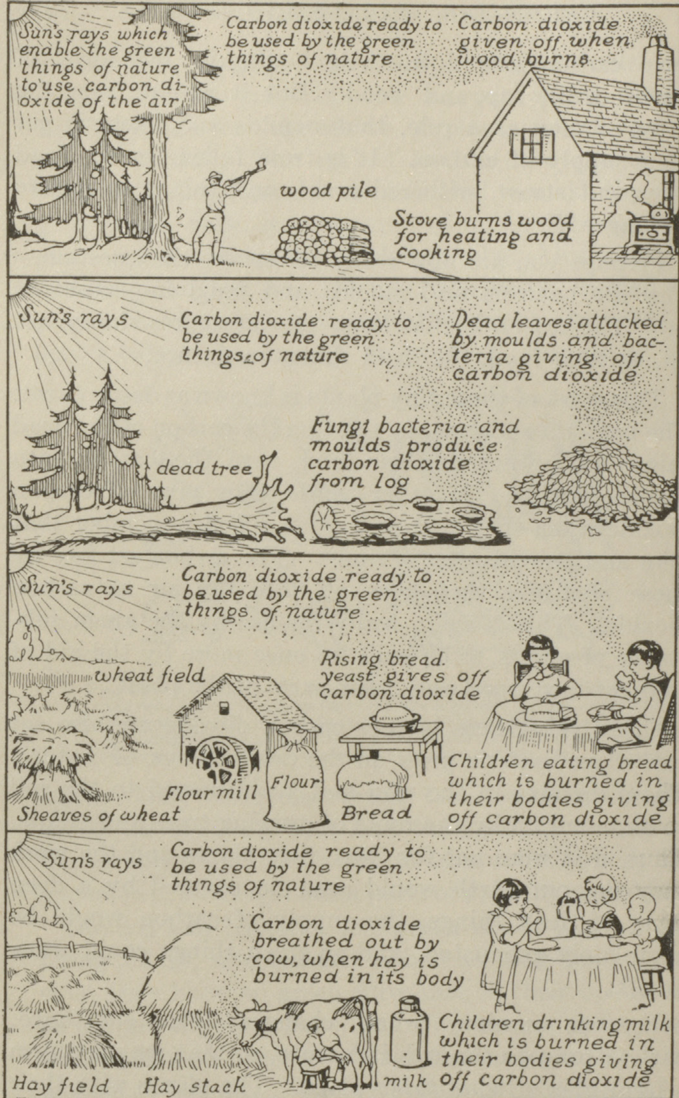

FIG. 54.—Changes which the wonderful substance carbon goes through in nature.

dioxide out of the air and turn it into wood, roots, bark, and other things, such as fruit, nuts, and grain.

Man and animals use as food the carbon made by plants. Part of the carbon is again changed in their bodies into carbon dioxide and is breathed out into the air. Some of the plant carbon is burned as fuel. This burning also changes carbon back to carbon dioxide. Bacteria, moulds, and fungi, however, use as their food very much more carbon than all that is used by animals or burned as fuel together. This means, of course, that they set free the carbon and return it to the air in the form of carbon dioxide. Thus these tiny creatures, which most people never think of at all, are really just as important in the world of nature as are the animals and plants. Indeed without them there could be no animals or plants.

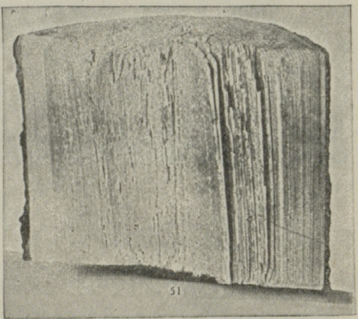

FIG. 55.—Log slowly being broken up by wood-rot fungus. *By courtesy of the Royal Society of Canada.*

How do such minute living plant cells accomplish such a giant's task? Let us see how enormous this task is. In Canada the woods, fields, and the countryside don a garment of green in Spring and Summer. The frost turns the green into the brilliant colours of Autumn. In Winter all is white except for our evergreens. Each year the same amount of carbon stored by the green things of nature must be returned to the air. If it were not so the supply of carbon would slowly be used up entirely. Nothing could grow at all.

Every boy and girl has seen an old fallen tree that has become decayed or rotten. What has happened is this: a tiny cell carried by the wind settles on the dead tree; with moisture and warmth it sends out small thread-like branches which in time spread deeper and deeper into the wood; these living threads produce a powerful substance which slowly softens and dissolves the wood; this dissolved material is absorbed and used as food for the growth of the mould. In this way the whole log becomes slowly broken up.

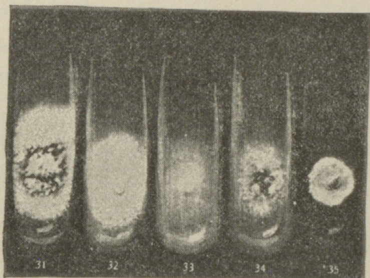

Fig. 56.—Wood-rot fungi grown in test tubes. These moulds grow in the dead wood of our forests and slowly break it up. *By courtesy of the Royal Society of Canada.*

In somewhat the same way bacteria act on meat. Every one knows how disagreeable the odour of meat becomes when it is exposed for a few days in warm weather. This is due to the action of bacteria, which produce substances which dissolve the meat, and also produce gas which has a very unpleasant odour.

The wood-rot mould and the bacteria which cause the decay of meat are two examples out of thousands and thousands to illustrate that each kind of germ forms substances from the food on which it lives. Some of these substances are very useful to us. For example, the bacteria that grow in the roots of clover, alfalfa, and certain legumes, make substances which are very good fertilizers of the soil. This is one of the reasons that clover is often sown, and the crop is then ploughed under in fields that have been used for several years

for wheat or other grains which use up the richness of the soil. If you examine the roots of a clover or an alfalfa plant, you will see many small lumps about the size of a pea. These lumps were once thought to be signs of disease in the plant. But now we know that they contain millions and millions of bacteria, which are able to use a gas from the air—nitrogen—and turn it into the substances which help to make the soil richer.

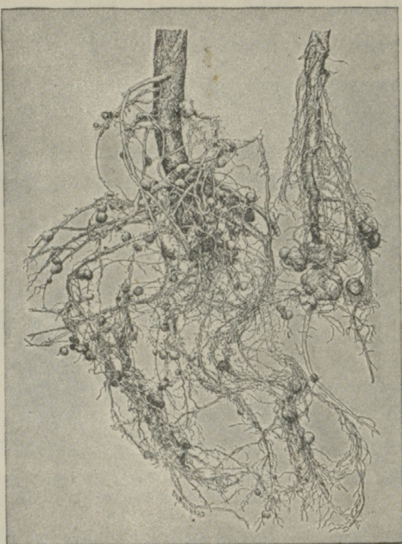

FIG. 57.—Roots of soy beans showing nodules. *By courtesy of U. S. Department of Agriculture, Washington.*

Some bacteria produce a pleasant flavour in cheese, others will make the cheese unfit for use. The undesirable germs in the milk are first killed by heating—a process called pasteurization about which you will learn more later. Then the cheesemaker actually puts in the useful germs. He calls them a "starter," because they go on increasing in number, and he knows that they will produce a good flavour in the cheese.

Most moulds and bacteria grow, as we have said, on the dead things of nature. However, there are some which also attack living plants and animals. When this happens, germs become our enemies and are no longer our useful allies.

Let us consider how these enemies do their damage. Some of you may have seen in the orchard the leaves of an apple-tree suddenly turn brown and become shrivelled. What has happened? Bacteria have grown down the twigs under the bark, and, by the poisons (called toxins), they have produced, the twigs are killed and the leaves die. The apple-tree is suffering from a disease. This disease is known as twig blight or fire blight, because the leaves turn brown as if scorched

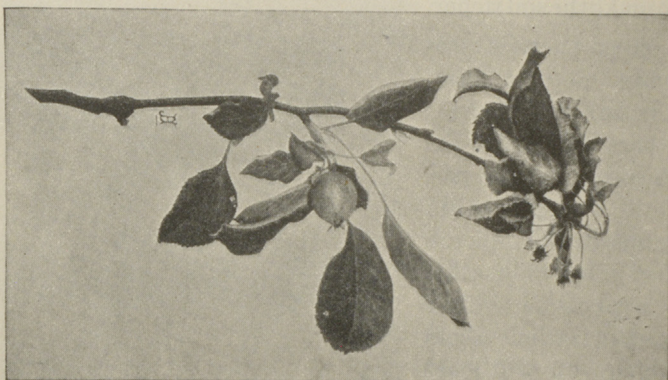

FIG. 58.—This apple-tree has been attacked by fire blight which has already shrivelled up the leaves at the tip of a branch.

by fire. This is one example of the hundreds of diseases that attack our trees, our fruits, and our vegetables. Perhaps you can mention other plant diseases.

Just as in the case of fire blight germs that produce a disease of living fruit-trees, so too, there are enemies that attack us and cause disease by the harmful toxins they produce in our bodies.

Thus we see that the substances produced by bacteria when they grow, are sometimes very useful, as in the case of the "starter" of the dairyman and the bacteria

growing in the clover roots. But there are also substances produced by the germs of disease, like fire blight, which are very destructive.

What is more important to us, however, are the harmful effects of the poisons of the germs that attack boys and girls and men and women.

CHAPTER III.

GERMS—HOW THEY GROW AND SPREAD

THERE are many, many thousands of different kinds of tiny germs of different shapes, all too small to be seen without a microscope. Some are round like little marbles; some grow in chains which look much like a necklace of beads; others are crescent-shaped, appearing under the microscope something like the new moon. Others, again, look like dumb-bells. Indeed they are of almost every imaginable shape.

FIG. 59.—Some common shapes of germs. *From Winslow's Healthy Living, by permission of the publishers, Charles E. Merrill Company.*

It is rather difficult for us to realize how very small these little living specks are. If you make a line on paper one inch long and carefully divide it into halves, then quarters, eighths, sixteenths, and so on, you soon discover that you cannot make very many divisions before it is not possible

to divide the inch further with a mark of your pencil. If you could divide the line into 25,000 parts, one of these parts would be about the width of some germs. The head of a pin, if covered with one layer of these minute forms of life, would carry about 500,000 of them. But if many millions are heaped up together, you can then actually see the little heap without the aid of a microscope. No one can see with unaided eye the minute cells that make up mould; yet on bread you have all seen blue-mould that is made up of many small cells growing together, each of which is too small for the eye to see.

Where do these little living particles which we have been learning about come from? For two centuries after Leeuwenhoek discovered bacteria, it was thought they came from the things in which they were growing. For example, if bacteria were found in sour milk, people thought they had been made from the milk itself. Pasteur showed that this idea was wrong. He proved that each kind of germ came from a germ exactly like it. For example, the yeast which our mothers or the bakers use in baking bread comes from other yeast cells, which were exactly like the ones that may be seen with a microscope in the dough before it is put into the oven. The early settlers in Canada made use of this fact. Yeast for bread-making could not be bought in those days from the corner grocery neatly packed in tinfoil or in cakes in air-tight, sealed boxes. After each bread-making a small amount of the dough was set aside, and mixed with fresh flour at the time of the next baking.

The modern manufacturer of yeast carefully selects one single yeast cell, and, by supplying it with warmth

and suitable food, is sure that he will obtain a great quantity of yeast exactly similar to the single cell he first selected.

Aided by warmth and moisture the cells of the yeast again begin to grow rapidly in flour or dough, and in growing, produce so much gas, carbon-dioxide, from the starch in the flour that the dough becomes filled with bubbles. We speak of this as "rising" bread. When the dough is put into the oven, the loaf hardens and entraps the gas, so that the bread is full of small holes, thus making the bread light.

How do bacteria grow? When a potato plant grows, it gets bigger by forming new leaves, a larger stem, and new roots. But bacteria grow by forming new ones just like themselves. For example, when a cell, which in the case of bacteria is really the whole plant, grows to be a certain size, it divides into two.

After a time under suitable conditions of moisture and warmth, each of these two cells also divides, and so the process continues. If they are cold they will not grow, and if they are too hot they will die, as you will learn later. This division may take place every half-hour. How many bacteria would there be in twenty-four hours? If you work out the correct answer, the figure would be so large that you could not imagine such a great number. Such a rapid division does not continue for very long, because the food supply is soon used up. They cannot grow without proper food.

There are some bacteria which grow for a certain time, and then, when the food supply begins to be used up or the weather becomes cold or dry, they change into little thick-walled particles called spores. These spores are somewhat like the seeds of plants and can live

without food for a long time and in any weather. When the spore is carried by the water or the wind to a place where there is food, moisture, and warmth, it grows just as does the seed when put into the ground. The spore grows into a single-celled plant just like the one from which it came, and the seed grows into a many-celled plant exactly similar to the one from which it was formed.

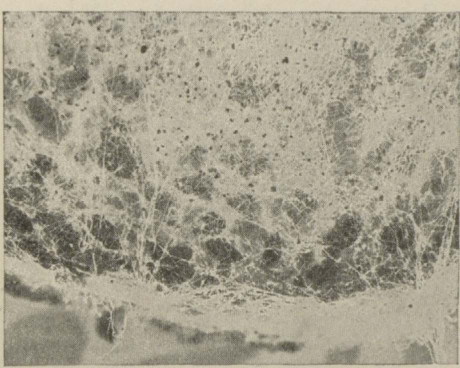

Fig. 60.—Mould growing on moist bread. Notice the little black dots, each of which is made up of thousands of little spores.

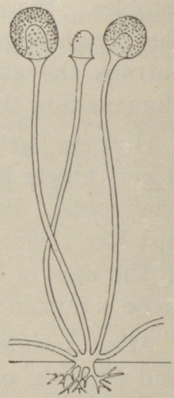

Fig. 61.—Three tufts seen under the microscope, the one in the centre has had its spores blown away by the wind.

The first cousins of bacteria—the various moulds—begin to grow from a single-celled plant like the bacteria. As they continue to grow, long threads of cells form. These after a time produce tiny tufts, which are visible to our eyes. These tufts are made up of thousands of spores, which are ready to be carried off by the wind to find a suitable place in which to grow.

Try this experiment some time in your school-room. Place a slice of bread on a plate and keep it moist with

water. After a time you will see a mould appear. Watch it every day and look for the tufts with a magnifying-glass. A slice of apple may be used in place of the bread.

Bacteria and moulds are practically everywhere, but not, of course, in rocks, in iron, or deep in the earth. How do these tiny creatures get about? They are so small and light that they may be spread by the wind. The experienced camper makes use of this fact when he mixes flour and water in a tin pail and hangs it on the limb of a tree in the sun. Sooner or later a small yeast cell carried by the breeze drops into the dough. It grows rapidly upon the starch in the flour and causes it to produce gas, or to ferment. This is exactly what happens in bread-making. This dough is called sourdough and makes excellent pancakes.

Fig. 62.—Bacteria of fire blight seen under the microscope. Showing tiny hairs by means of which it moves about.

Water, too, like the wind, may aid in carrying bacteria from place to place. For example, drops of rain carry the bacteria which cause fire blight from one leaf to another, which is growing lower down on the tree. These and some other germs are also able to move by their own efforts. They have tiny hairs at one end and are able by means of these to pull themselves forward in

water in much the same way as the propeller of an aeroplane draws the machine forward through the air. Germs cannot jump, or fly, or walk. Most of those which are harmful to us, however, are spread from one person to another by a very short and direct way.

When a disease spreads from one person to another, we call it a catching or a communicable disease.

The germs of many communicable diseases are found in the moisture of the nose and throat of the sick person, as in the case of diphtheria. When he sneezes or coughs, very fine droplets of saliva are formed which are like a fine spray. These droplets are laden with bacteria and may hang in the air for some minutes and be breathed in by a person near by. Of course the germs of the mouth are also spread about by spitting. Pencils and other articles, and very often fingers, also, find their way to the mouth, become covered with saliva, and thus serve to spread the germs. The things we touch, such as door-handles, may have been wet by fingers that have recently been in the mouth or on the lips of other boys and girls; and our fingers soiled in this manner may soon find their way to our own mouths. Thus saliva, door-handles, and fingers have each been links in the chain by which germs have been carried from the mouth of one person to the mouth of another. Similarly, handkerchiefs, towels, spoons, forks, and dishes may carry disease germs.

How is it then, that if there are so many ways of getting germs from other people into our mouths, that we do not become sick more often than we do? One reason is that most of these harmful germs cannot grow outside the body. Indeed most of them are able to live but a very short time without the moisture

and warmth of the body. Dead germs, of course, cannot cause disease. Drying kills them quickly. Direct sunlight kills some kinds in a few minutes. Even the germ of tuberculosis, which is much more difficult to kill than some others, may be killed by direct sunlight in two hours.

The likelihood of catching a disease like diphtheria is not great if we remember never to put into our mouths anything that may have been recently in contact with the moisture of the nose or mouth of some other person, and if, in addition, other boys and girls are careful not to cough or sneeze without first covering the mouth with their own handkerchief.

Since the hands may carry disease-producing germs, it is very important to remember always to wash the hands before eating. Thorough washing with soap and handbrush will remove a great many germs.

The mouth is the gateway by which germs of many diseases enter the body, and the brain should act as sentinel, always alert to guard against the entrance of the enemy.

These, then, are good rules that every boy and girl should follow:

1. When you cough or sneeze, be sure first to cover your mouth with your own handkerchief.

2. Use your own handkerchief. Never allow it to touch anything or anybody except your own self.

3. Always use your own towel.

There should be no public towels anywhere. Paper towels should be supplied in public washrooms.

4. Wash your hands before meals.

5. Keep your fingers out of your mouth.

6. Put nothing into your mouth that is not intended to be put there.

7. Never use a public drinking-cup. Individual paper cups should be supplied in all public places.

8. Do not spit.

CHAPTER IV

SOME WAYS OF PREVENTING THE SPREAD OF GERMS

We have learned that by far the greater number of germs are really our friends, working in many different ways for us—in the fields and forest, in the bakery, and in the cheese factory. How can we guard against the few that are our enemies? One way is to prevent, when possible, these enemies from spreading; that is, from passing from the bodies of those who are sick and entering the bodies of those who are well. When a disease spreads rapidly from one person to another, and therefore many become sick at one time, we speak of it as an epidemic.

How may epidemics be prevented? When a person is sick, for example, if all other people are kept away and all the things that he uses (such as handkerchiefs, and dishes, which may have the germs causing the disease on them) are not used by others, then the disease can not spread. Of course these precautions cannot be completely and perfectly observed, because the sick person must be looked after by some one who is constantly attending to his needs.

Much, however, can be done to prevent others catching the disease, so that it may not spread or become epidemic. Dishes and linen used by the sick person must be boiled, in order to kill the germs, since boiling is one of

the simplest and best way to accomplish this. The attendant must be careful at all times to keep her hands free from germs by frequent washing; and she must not mingle with others more than is really necessary. Flies must also be kept out of the sick room, and from all things that have been in contact with the patient, in order that they may not spread disease germs to the food and drink of others.

DIPHTHERIA

HERE

No person shall remove this card without permission of the Board of Health or one of its officers, and any person doing so shall be liable for every such offence to a penalty of not less than $5.00, nor more than $50.00.

Fig. 63.—A placard used by Health Departments.

As soon as the Department of Public Health is notified by the doctor of a case of "catching" or communicable disease, an inspector is sent to instruct the parents how to look after the sick person, in order, if possible, that the disease may not spread to others. In addition, a card is placed on the door with "*Diphtheria*" or whatever the disease may be, written in large letters on it, for the purpose of warning others not to enter the house.

If these precautions are taken, the sick person is spoken of as being isolated. The word isolate comes

from the Latin word, *insula*, an island, and the meaning in this connection is that the individual is set apart, or placed by himself, very much as an island is surrounded by water and separated from other areas of land.

The house with the placard is under quarantine. Quarantine also comes from a Latin word meaning forty. In Venice, hundreds of years ago, ships on which sickness had broken out at sea were not allowed to enter a port for forty days. Nowadays, however, when a house is under quarantine, it means that the people in the house must not mingle with the outside world for a certain time, which is laid down by law for each communicable disease.

Isolation and quarantine sometimes cause great inconvenience, but like many other disagreeable things must be carried out for the benefit of others.

Isolation of a patient suffering from a communicable disease and quarantine of those who have been in contact with him, are means by which we attempt to keep disease from other homes.

How may these diseases be kept out of the country? For example, suppose we read in the newspaper that an epidemic of cholera, a very deadly disease, has broken out in India. Our country is so very far away that perhaps we think that it could never reach our shores. But it can. With the fast ocean liners and fast trains, it might be but a few weeks before the disease would be carried to our own community. To prevent this the Health Service examines the people coming to our country in ships, and keeps all people with communicable diseases from landing on our shores. Ships coming from parts of the world where there are epidemics of cholera, for instance, are more carefully watched than others.

The League of Nations has made use of radio to inform all countries when and where an epidemic occurs, in order to warn the Health Services to be on their guard.

One might think that, if the law in regard to isolation and quarantine were obeyed, and that if every one made an effort to carry out the spirit as well as the letter of the law, communicable diseases might be prevented altogether. But their prevention is not such a simple matter. It is quite true, of course, that if you lived in the woods by yourself, as a trapper or camper, you would never catch whooping-cough, because there would be no one from whom to get the germs of whooping-cough.

Nansen, the Arctic explorer, relates in his book *Farthest North* how, though exposed to great hardships and to intense cold, his men remained free from colds. That was because, once free from colds, there was no means of getting the germs of colds into their noses and throats, because there was no one from whom to catch them. As soon as these strong and hardy men, however, reached civilization, they promptly suffered from colds because the germs of colds were about in the noses and throats of the people they met. Boys and girls are not isolated for months at a time, as trappers and explorers are; they must go to school and mingle with others in their work and play, and live with their brothers and sisters at home. For this reason they are often brought into contact with others who may have disease producing germs in their noses and throats.

Though isolation and quarantine, as carried out at the present time, help to prevent disease from spreading, they do not stop it altogether. One reason for this is that some diseases are catching or communicable before

the person who has such a disease falls sick. This is especially true in the case of whooping-cough, measles, and chicken-pox. How may a boy have whooping-cough and spread the disease to others if he is himself not ill? This is the answer. When the germs of whooping-cough get into the air passages of the lungs of a school boy, they lodge there and begin to grow. For a few days the boy does not feel quite himself. He may not even stay away from school. The poisons of the germs of whooping-cough gradually affect the throat, and a cough develops which is often mistaken for a slight cold. By coughing or sneezing, the whooping-cough germs are violently expelled into the air with the moisture from the mouth, in the form of spray. This germ-laden spray may be breathed in by another boy, who in this way gets the germs in his throat and later may develop whooping-cough.

Another reason for the difficulty in preventing the spread of communicable diseases is that sometimes a disease—scarlet fever, for example—is so mild in form that no one realizes that the boy or girl really has scarlet fever at all. Possibly the parents may keep a boy at home for a day or two, and, without realizing the danger to others, allow him to return to school while the germs of scarlet fever are still in his throat. He may thus spread the germs to his schoolmates.

This boy, who had such a mild case of scarlet fever, may cause others to catch the disease, not in a mild form but in a very severe form; for a disease may be mild in one case and severe in the next.

Unfortunately, there is still a third great difficulty to be overcome in preventing epidemics. There are people in whose bodies the germs of disease may be

growing, but who are not ill at all and who are not even developing any disease. Such persons are spoken of as "carriers." It seems very strange that if the germs of a disease, for instance, diphtheria, are growing in the throats of certain people, they may still be quite well. Carriers may, however, spread the germs to others, and thus cause them to become ill. Diphtheria, scarlet fever, and typhoid are diseases which may be spread by "carriers."

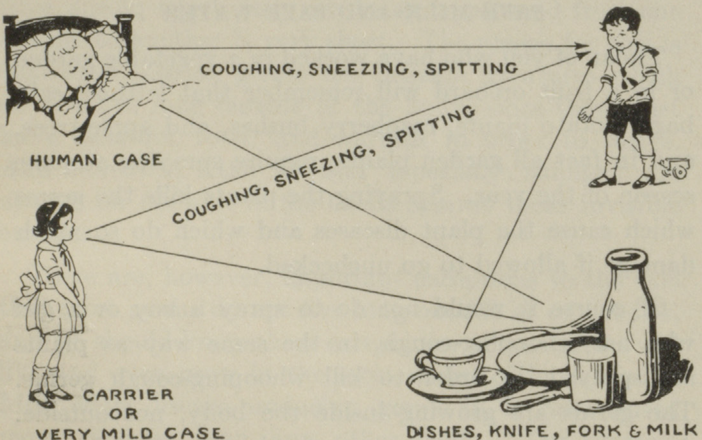

FIG. 64.—Ways in which the germs of disease may be spread from the nose and throat.

There are then these three groups of people, besides those who are actually sick, who may spread communicable diseases: (*a*) those who are getting a disease, but are not, as yet, sick enough to know that they have it, (*b*) those that have a disease in so mild a form that it is not even recognized that they have a communicable disease, (*c*) and carriers who are well, but in whose bodies there are living germs, which if transferred to others may produce disease.

From this we may see how hard it is to prevent the spread of disease; but perhaps some time in the far off future, when all people and all nations work together, the words of the great Pasteur may become true: "It is in the power of man to cause communicable diseases to disappear from the face of the earth."

CHAPTER V.

SAFE MILK AND SAFE WATER

Those of you who have worked in a vegetable garden or in a fruit orchard will remember that lettuce, cabbage, potato plants, raspberry bushes, and apple-trees, and in fact all garden plants, require spraying at some season of the year. Spraying the plants kills the germs which cause the plant diseases and which do so much damage if allowed to go unchecked.

Of course it would not do to spray a boy or a girl who has whooping-cough, in the same way as plants are sprayed, in order to kill whooping-cough germs. The germs are growing inside the body, not outside. A spray, moreover, poisonous to the germ, might also be poisonous to the person who has whooping-cough. If these germs, then, are to be killed at all, it must be done while they are outside the body.

One of the simplest and best ways of killing germs, as we have seen, is by heat—either by boiling, or baking in an oven. Thus the germs on the dishes, cutlery, handkerchiefs, and bed linen of a person with a communicable disease may be killed by boiling these articles for a few minutes. Scrubbing the hands with hot water

and soap is the best way to rid them of germs, for, of course, hands cannot be boiled like linen or sprayed like plants.

The germ enemies of boys and girls are usually spread from one person to another by coughing, sneezing, or any other way which permits the germs of the mouth or nose of one person to reach, in a very short time, the mouth or nose of another. It is important, however, to know that germs are not likely to spread unless the time during which they are being transferred from one person to another is very short. The reason for this is that most disease germs are delicate creatures which do not live long outside of the body, since they must have moisture, food, and warmth in order to thrive. And moreover, fresh air and especially sunlight are always on our side in the battle against these invisible enemies.

There are, however, important exceptions to the rule that most germs do not live long outside of our bodies, and we should know these exceptions. Some germs will live and even grow in the most useful of foods—milk. Milk with disease-producing germs in it has caused more sickness than any other food. The greatest possible care, then, should be exercised to keep germs out of milk. How do they get into it? One way is from the cow. Fortunately there is only one common disease, though a most important one, which the cow herself can get and which is communicable to man through milk. This is tuberculosis. Milk from cows which have tuberculosis may at certain stages of the disease, contain very great numbers of germs of tuberculosis. But disease germs may also get into milk during or after milking. If the milker's hands have disease-producing

germs on them, or if he coughs or sneezes over the milk pail, those germs are likely to get into the milk. Typhoid fever, scarlet fever, diphtheria, and tuberculosis are diseases which may be spread by milk. There is danger, too, in the handling of milk at the dairy and in the use of pails washed with water which is unfit for use.

Since germs can live and grow in milk, the longer it is on the way to the consumer and the warmer it is kept on the journey the more dangerous it becomes, because the germs have time to increase to very great numbers. Milk should therefore be kept cool at all times and used when fresh.

Fortunately there is a simple means of making milk safe. This is by pasteurization, which if properly carried out kills all disease-producing germs. Pasteurization consists in heating milk to 145 degrees, keeping it at that temperature for thirty minutes, and then cooling it rapidly. By this pasteurization the taste of milk is not changed, and except for a partial destruction of one of the vitamins contained in the milk, its value as a food is unchanged. A small amount of orange juice to replace the loss of the vitamins may be given to babies who are dependent wholly upon milk for food. Pasteurization may be carried out at home, but unless it is done with great care, it is much safer to boil milk.

The milk and cream for cheese and butter-making are pasteurized, not only to kill the germs that might cause disease, but also to kill those that might give a bad flavour to the dairy products if allowed to grow.

To have a clean milk supply, the stables, cows, and pails must be clean. To have a pure milk supply, not only must the stables, cows, and pails be clean, but also

the cows, milkers, and dairymen must be free from communicable diseases. To have a clean, pure, *safe* milk supply, not only must the above requirements be carried out, but in addition the milk must be pasteurized.

SAFE WATER

We have learned that there are certain exceptions to the rule that disease-producing germs do not live long outside the body. Many will live and even grow in milk, and for that reason the greatest possible care must be exercised to keep it free from them. Very few will

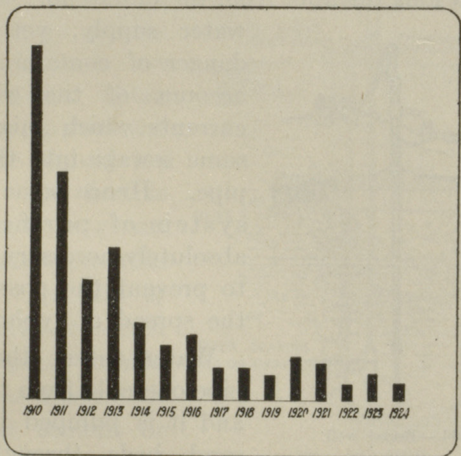

Fig. 65.—How the filtration and chlorination of water and the pasteurization of milk reduced the number of cases of typhoid fever in Toronto.

live in water, but one very important and dangerous kind may get into drinking-water and may live in it for days. These are the germs of typhoid fever.

This disease used to be much more common than it is to-day. Formerly it was not known how typhoid fever spread among the people. Now we know that

germs of this disease get into the drinking-water from the sewage, and that this very commonly causes the spread of the fever. Engineers carefully guard against this possibility nowadays by building good sewage disposal systems, and in those places where there is danger of sewage entering the drinking water, they have constructed water purification plants, in order to make the water safe to drink.

Let us see how a large city like Toronto is supplied with safe water. Although the sewer mains empty into the lake a long distance from the intake pipe of the city water supply, yet there is danger of contamination on account of the winds and currents which might carry some sewage into the intake pipe. Hence some effective system of purification is absolutely necessary, in order to prevent the possibility of the spread of typhoid fever.

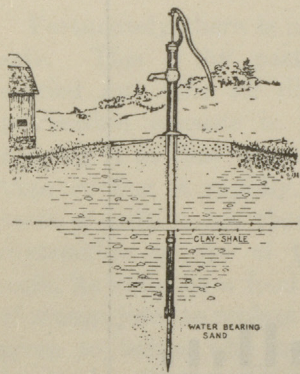

Fig. 66.—Bored well.

Water enters the intake pipe one mile from the shore, and it is pumped into large sand beds through which it filters. These sand beds are carefully made with fine sand on top, coarser sand and gravel underneath, and with a system of pipes on the bottom to collect the water that has been filtered through the sand. In order to kill the few germs that go through the sand, the water is then chlorinated. This is a process by which a certain substance, called chlorine, is carefully added to the water.

The amount of water used in Toronto is very great. As much as 110 gallons of water are purified and pumped for each individual in the city every day. But how may one make small amounts of water, such as are used in camping or in a small household, safe? The answer is by boiling it. This will kill all typhoid germs at once. Of course there is no need of this at all if harmful germs are kept out of the water.

In Ontario many people get their water from wells. Let us learn some things about them to help us to make them safe. There are two important points one should remember. The first is that dangerous germs may get into them from the top. The top of a well is best protected by a sloping cement covering as illustrated. Note that cement or brick-work is carried down the sides to prevent surface water from draining into the well. The second point is that dangerous germs may enter from the sides and the bottom. To prevent this proper masonry is built, lining the well. Drilled or bored wells are more easily protected than wells that are dug. In addition, human and animal waste must be disposed of in such a way that rain will not carry any of it into the well.

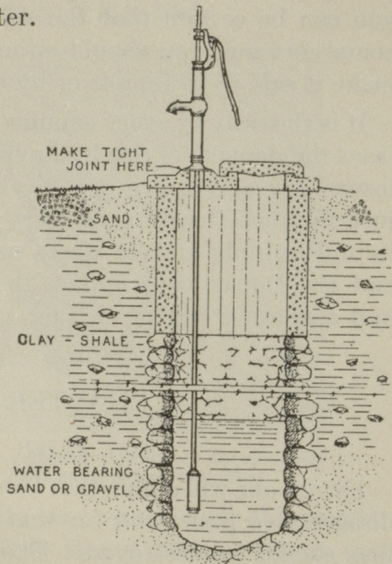

FIG. 67.—Well.

Spring water may be as clear as crystal and yet be unsafe, because if at any place sewage water enters the spring, it may have typhoid germs in it. The germs are so small that there may be thousands of them in the water without making it look unclean in the least degree. The lesson to remember from this is that you should never judge a water by its appearance, and unless you can be certain that the water is free from sewage contamination, you should either not drink it at all or make it safe by boiling it or by chlorination.

It is the duty of every community to guard its citizens from the dangers of fire by having a fire department, to insure law and order by having a police force, it is just as much the duty of every community to see that its milk supply and its water supply are safe. To this end the Department of Health will gladly give advice and assistance free of charge.

CHAPTER VI

FLIES

Every one will admit that house-flies are troublesome, disagreeable pests, and for that reason, if for no other, flies should be destroyed. There is, however, a much better reason for carrying on active warfare against them. They are spreaders of disease. If we study the habits and the development of flies, we shall learn what undesirable neighbours they are and how they may be most readily destroyed.

The house-fly, since it is found in and about the dwellings of man, is the commonest and the most likely fly to spread disease. This becomes very clear when we examine its habits and manner of living. Flies lay

great numbers of eggs. As many as 600 in a season are laid by a single fly. These eggs are tiny white oblong cylinders about one-sixth of an inch long. If you wish to see them for yourself, you will be sure to find them if you place a piece of meat in the open air in midsummer. The "blue-bottles" or blow-flies are likely to be the first to find it, for they have a very keen sense of smell for meat, especially if it is bad.

FIG. 68.—The house-fly—a spreader of disease. *By permission of The Syndics of The Cambridge University Press.*

Flies, wasps, bees, and many insects have this wonderful power of smell. This is not strange, since their eyesight is very poor as compared with that of man. Notice the large queer eyes of a fly the next time you catch one. These eyes are made up of many tiny eyes set one beside the other like small panes of glass in a window. A fly can see but a very short distance and not at all clearly.

Insects, then, need a keen sense that will tell them whether a foe or a friend is near and will guide them long distances to their food. This they have in their

keen sense of smell. This wonderful sense is in their "feelers" or antennae. When a spider is brought near a wasp, these antennae begin to wave gently and point in the direction of the spider. They are picking up the scent. Suddenly the wasp darts at the spider, stings it, and carries it off.

But the fly is guided both to dainty foods and to those that are offensive. It prefers manure about a stable as a place in which to lay eggs. If that is not available, garbage and decaying animal matter of all sorts will serve the purpose as well, since the larvae or maggots which hatch from the eggs must have food ready for them.

The larvae look something like small caterpillars. After eating and growing very quickly for about five days, during which time they shed their skin twice because it becomes too snug, they rest for five days. During this resting period the fly develops inside a thin case, much in the same way as a butterfly develops in a cocoon.

Thus, after about ten days, the egg has developed by stages into a fly which is now able to search for its food; and with his long antennae "tuned" to pick up smells, makes for the nearest kitchen or garbage pail. In its search for food it goes from one place to another. It may feed on the waste material from our digestive system or on the secretions from the mouth or nose, if these are not properly disposed of, and its next feeding place may be the sugar bowl or the milk jug.

You know that typhoid fever is spread by water contaminated by sewage which contains the typhoid germs from the intestinal canal of a person suffering from typhoid fever. Flies feeding on this intestinal

waste may carry typhoid germs on their hairy legs and in their own digestive system directly to our milk or other food.

The mouth of a house-fly is a sort of tube with small suckers at the end to draw fluid into its stomach. It also uses the fluid in its stomach to moisten its food, and thus may transfer the germs from the material it has been feeding on directly to our own food. Fly-specks are dried intestinal discharges. Is it not clear, then, that the more we learn about the tastes and habits of the house-fly the more undesirable a neighbour it seems?

Fig. 69.—The hairy foot of a house-fly seen under the microscope. The fly may carry millions of germs on his feet and body. *From Overton and Denno's "The Health Officer." Courtesy of W. B. Saunders Company.*

There are two means by which one's food may be kept free from the visits of flies. One is to destroy the flies; the other to protect food from them by screened doors and windows. The first means is, of course, the more desirable. However, to carry this out well, not only you, but your neighbour, must prevent flies from developing by destroying their breeding places. Garbage cans must have tightly fitting lids, and all human and animal waste must be disposed of with great care.

House-flies do not, as a rule, fly far from the place they breed in, so that the more flies there are in your neighbourhood, the more breeding places there are.

These are important things to remember about flies:

1. That they are spreaders of disease.

2. That all waste matter from our bodies must be carefully disposed of in order that flies may not get at it.

3. That all our food must be screened against flies.

For further information regarding the disposal of human and animal waste see Bulletin No. 9 issued by the Provincial Board of Health.

CHAPTER VII

BUILDING FORTS AGAINST THE UNSEEN ENEMY

In previous Chapters some of the things that can be done to prevent the spread of disease have been described. The body must be kept in good running order, by developing habits of healthy living, by making milk and water safe, by the proper disposal of germs from the body of a person suffering from a communicable disease, and by paying attention to isolation and quarantine. All these help greatly in the prevention of disease.

Except in the case of forming habits of healthy living, these measures have to do, not with the body itself, but with ways of preventing disease-producing germs from being carried from the sick person to the well person. In other words, by knowing the ways and habits of the enemy we are able to attack him before he attacks us. But we must not neglect or forget our own defences. Our bodies must be trained to fight the unseen enemy. Are there any forts which help to defend our bodies? Fortunately there are a number of them.

First of all let us consider some of the forts the enemy must capture before he enters our bodies. One of these forts is the skin. Germs cannot get through it unless there is a cut or a scratch. For example, the germ of tetanus or lock-jaw, as it is often called, does no harm on the skin, but if it enters into a deep wound, then, unless we call upon a staunch ally, about which you will learn later, lock-jaw will develop.

Another fort of the body is the twisty channel of the nose, which is protected by small hairs and covered with a sticky moist fluid which traps dust and germs and helps to prevent the germs from entering the lungs.

However, these outside forts are not as important as they would seem, for most of the germs of communicable diseases enter the body by way of the nose and throat or grow in the nose and throat where they produce the poisons which are carried by the blood streams to do damage to other parts of the body. For example, scarlet fever and diphtheria germs grow in the throat and produce such strong poisons that they make us very sick indeed.

There are, then, other defences besides the outside forts which the body possesses and which are much more important. They are, however, very mysterious. It has been discovered how some of them act, but of the action of others we have little knowledge as yet.

Every one knows that if a person has once had a communicable disease he is very unlikely to get that disease again. This is true, for example, of smallpox, typhoid fever, and scarlet fever. Some change has been produced in the body by an attack of each of these diseases that enables it to protect itself from future attacks. We speak of this power as immunity (from the Latin

word meaning "freedom from.") Immunity, then, is freedom from the possibility of catching disease.

One may readily understand that this is not a very desirable way to obtain immunity. If this were the only way to be protected against each of the above diseases one would first have to suffer from the disease itself. Would it not be a wonderful thing if one could be protected against a disease without ever having had it? Fortunately this can be done in the case of a certain number of diseases. There is no doubt whatever that during the next few years success will be achieved in the case of many others.

The first disease against which man learned to protect himself by training his body to set up or produce its own immunity was smallpox. One hundred years ago smallpox was a very common disease. It is said that as many as 400,000 died of it every year. In addition, the faces of many of those who had smallpox in childhood were disfigured by the scars left by the disease. Poor people and princes alike were laid low. Mary, the wife of William of Orange; Emperor Joseph of Germany; Peter, Emperor of Russia, all died of smallpox. Other notable persons suffered from the disease but escaped death, as, for example, Queen Anne of England and Louis XIV of France. So dreadful a scourge was it that people sought to protect themselves and their children by putting in their arms a small amount of smallpox material. In other words, the disease was purposely spread from the sick person to the well person. This, of course, nowadays, is just what we wish to prevent. Indeed, we do our utmost to prevent the spread of any disease. However, when smallpox was transferred by this method, it

usually produced a mild attack of the disease, and those having had it in this way were immune to it, which means they could not get the disease again. This means of becoming protected was very dangerous, because, even though only a mild type of smallpox was usually the result, sometimes the attack was so severe as to cause death.

It was Edward Jenner, an Englishman, who about a century ago made the wonderful discovery that the body could be made immune against this terrible disease. While on a visit at the country-house of a friend, he fell into conversation with one of the dairymaids, the beauty of whose complexion astonished him. "How sad it would be if smallpox should ruin that pretty face of yours," said Jenner. "Oh, but it cannot," answered the dairymaid, "because I have had cowpox." Jenner thought about the answer of the dairymaid and decided to investigate the matter further. He knew that the disease, cowpox, would never be dangerous in human beings, and, if by producing a slight attack of cowpox on a boy's arm he could protect the lad against smallpox, it would be a wonderful discovery. He therefore tried an experiment. He took some of the cowpox material from Sarah Nelmess and transferred it to the arm of a little

FIG. 70.—Edward Jenner. *Courtesy of Yale University Press.*

boy, John Phipps. In a few days the arm of the little boy began to show a small red area which looked exactly like that which shows on our arms nowadays when we are vaccinated. Later on a whitish scar was left in the place where the vaccination had been done.

After many carefully planned trials, Jenner was able to prove beyond the shadow of a doubt the truth of the answer of the dairymaid, when she said her complexion would always be free from the scars of smallpox because she had had cowpox.

Since the time of Jenner there have been, of course, a great many changes and improvements in the method of preparation of the cowpox material used for vaccination. At the present time healthy calves are carefully chosen and are given purified cowpox material, which produces cowpox on their skins. Exactly the same care is taken in the preparation of the skin of the calf as a modern surgeon exercises in the preparation of a patient for operation. Even the sawdust used for bedding for the calf is treated with steam in order to kill the germs on it. The cowpox material, called vaccine, is taken from the calf immediately after the animal has been killed. This vaccine is purified and later put into tiny sterilized tubes ready for use.

It has been found that in most people one vaccination does not protect against smallpox for life, so that it is better for every one to be vaccinated in early infancy and again on entering school.

Because of the careful observations of Edward Jenner, a means of protection against smallpox has been found which has meant the saving of millions of human lives. Indeed we have the means in our power of destroying smallpox altogether. If every one in the world

were vaccinated to-morrow, there is no known reason why smallpox should not disappear from the face of the earth.

In the early history of Canada the Indians suffered an enormous loss of lives from smallpox. Indeed an early historian stated that it was largely responsible for the almost complete disappearance of the Indians from the country.

In *David Thompson's Narrative* the Indians said to him: "We thus continued to advance through fine plains to the Stag River, then death came over us all, and swept away more than half of us by the smallpox, of which we knew nothing till it brought death amongst us. We caught it from the Snake Indians . . . this dreadful disease broke out in our camp, and spread from one tent to another as if the Bad Spirit carried it. We had no belief that one man could give it to another, any more than a wounded man could give his wound to another."

In 1808 Indians in Canada sent the following letter to Edward Jenner:

"Brother:

Our Father has delivered to us the book you sent to instruct us how to use the discovery which the Great Spirit made to you, whereby the smallpox, that fatal enemy of our tribe, may be driven from the earth. We have deposited your books in the hands of a man of skill, whom our Great Father employs to attend to us when sick and wounded. We shall not fail to teach our children to speak the name of Jenner and to thank the Great Spirit for bestowing upon him so much wisdom and benevolence. We send with this a belt and string of

wampum in token of our acceptance of your precious gift, and we beseech the Great Spirit to take care of you in this world and in the land of spirits."

CHAPTER VIII

MORE FORTS AGAINST UNSEEN ENEMIES

Typhoid fever is another disease which we have learned to prevent by making the body set up defences against it. We have learned that this disease is commonly spread by water and by milk which have been contaminated by the germs of that disease, and by flies. Thus, by having a safe water and a safe milk supply, and by keeping flies away from the germs, much can be done to prevent the disease from spreading. Sometimes, however, these safeguards are not properly observed.

In the Boer war, during only two and a half years over eight thousand died of typhoid fever—many more than were killed in battle. But in the recent Great War which lasted four years, there were only fourteen Canadian soldiers who died from the disease. There were 420,000 men in the Canadian forces, as compared with 548,237 of the British forces in South Africa.

Why was there such a decrease in the deaths due to typhoid fever? The chief reason was that the soldiers in the Great War were protected against typhoid fever, or in other words, they were given immunity against it before they reached France. This was done, because by experience men had learned that during warfare safe water and safe milk could not always be supplied, nor could flies be kept from food, and hence the risk of typhoid fever was very great.

How is this immunity from typhoid produced? The germs of typhoid fever can readily be grown in glass tubes, by persons who are specially trained. For this purpose glass tubes containing suitable food material for the germs are used. Very large numbers of these germs are then grown, and are killed by heating them to the proper degree of temperature. A certain amount of these killed typhoid germs, mixed with water, is put into the arm under the skin, with a hollow needle. Of course these germs cannot cause typhoid fever, because they are dead germs and will never come back to life. How then can they protect one against typhoid fever? In the body these dead germs are slowly dissolved, and substances are set free from them which may cause slight fever and headache. But the body soon destroys these, and in so doing produces in their place protective substances. In about six weeks after proper doses of killed germs have been given, the body has made sufficient of these protective substances to be able to defend itself against living typhoid germs, if they happen to enter the body in water or food.

It must be remembered, however, that the protection or immunity against typhoid is not as sure nor does it last as long as the protection against smallpox produced by vaccination. Against both of these diseases the immunity may require to be renewed or strengthened from time to time.

There is another disease, diphtheria, against which we may build in our bodies an invisible fort. How may this be done? Before we answer this question let us see why diphtheria is such a dangerous disease. When diphtheria germs are grown outside of the body, in a fluid much like clear beef broth, they produce one

of the most powerful poisons known, called diphtheria toxin. It is the same poison which does harm to us when we get the disease, diphtheria.

Fortunately, however, this toxin can be changed in such a way as to make it no longer poisonous. When this changed non-poisonous toxin is put into our bodies under the skin, it will cause us to make a protective substance called antipoison or, more commonly, antitoxin. This is ready at all times to attack the diphtheria toxin produced in our throats if the germs of diphtheria happen to lodge and grow there. In this way, then, we are protected from diphtheria.

We have learned how we may train the body to defend itself against diphtheria by making its own protective antitoxin. What can be done when a person who is not immune to diphtheria gets the disease? The living germs growing in his throat produce diphtheria toxin so rapidly that his body has not time to manufacture its own antitoxin quickly enough to overcome the harmful effects of the toxin. What his body requires to fight the disease is this magic substance—antitoxin. But how can this be supplied? Fortunately other animals can make it for us, and we can supply it to the person suffering from diphtheria in such great quantities that the disease can be quickly cured. The discovery of how diphtheria antitoxin may be made by other animals for our use is one of the most wonderful discoveries of modern times.

We have just learned how our bodies can be made to produce their own antitoxin, which is ready to attack the toxin of the germs of diphtheria if they happen to grow in our throats. We can also, by the same method, make horses produce antitoxin in their own bodies.

For this purpose, strong, healthy horses are carefully chosen and kept in well-ventilated, clean stables. In the period of a few months these animals may be made to produce in their bodies a very great deal of antitoxin. From the blood of these healthy horses the wonderful life-saving diphtheria antitoxin may be obtained.

Diphtheria antitoxin was first used in Paris in 1894, under the direction of Roux, (*Roo,* as in *root*), a pupil of the great Pasteur. Children were cured of diphtheria as if by a miracle. Since that time the lives of thousands of boys and girls have been saved in every country where diphtheria exists. You may wonder why every child who has diphtheria is not cured by this wonderful antitoxin. The reason is that it is not given soon enough in every case. The longer the powerful diphtheria toxin is allowed to act in the body, the more difficult it is to overcome its harmful effects with antitoxin.

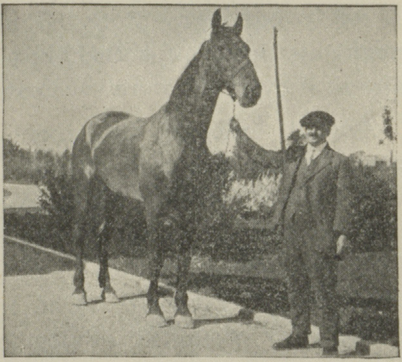

FIG. 71.—This horse has made enough diphtheria antitoxin to save the lives of many children.

Diphtheria is now not the dreaded disease it used to be before the magic antitoxin was discovered. Perhaps your grandfather or grandmother can tell you how diphtheria swept through the country and carried off so many lives. In those days sometimes more than one-third of those who had the disease died of it. Now in Ontario only five out of every one hundred attacked,

die. Indeed, if recognized early and if antitoxin is given soon enough, there should be no deaths from diphtheria at all.

For more than thirty years diphtheria antitoxin has proved to be one of the safest and most miraculous cures ever known.

Diphtheria antitoxin made for us by horses is used, then, for curing diphtheria. Diphtheria antitoxin made in our own bodies serves to protect us from the disease. If every one were protected in this way, diphtheria might disappear altogether, just as smallpox might disappear if everyone were vaccinated.

Against lock-jaw, too, there is an antitoxin. This powerful ally was used during the Great War, to prevent wounded soldiers who had got the germs of lock-jaw into the wound from the soil, from taking the disease. Lock-jaw among wounded soldiers in France was frequent before antitoxin came into general use. By giving every wounded soldier lock-jaw antitoxin, the disease was prevented from developing.

We have also an antitoxin against scarlet fever. This is made, like diphtheria and tetanus antitoxin, by horses, for our use.

There is little doubt that in the future a way of making more kinds of antitoxins for other diseases will be discovered.

Perhaps when you grow up, you will yourself make one of these wonderful discoveries.

CHAPTER IX

TESTING OUR DEFENCES

It would be very desirable indeed to find out whether or not a person were immune to certain communicable diseases. We have learned that an attack of measles or scarlet fever makes one immune to future attacks; that one may be made immune to smallpox and to diphtheria without having had either of them. But is it possible that a person may be immune to a disease without either having had the disease or without treatment of any kind? This is quite possible, and further, there is a simple means of finding it out in the case of diphtheria and scarlet fever.

Some people have antitoxin in their bodies, and others have not. Those who have enough diphtheria antitoxin will not get diphtheria, because it protects them. Those, on the other hand, who have not enough will get the disease if the germs of diphtheria lodge in their throats and grow there. How may one find out who has enough antitoxin in his body to protect him and who has not?

One cannot find out by simply looking at the outside of the body. Fortunately, however, there is a test known as the Schick Test, which will give us this information. The test is easily carried out. This is how it is done. A tiny drop of very much weakened diphtheria toxin is put carefully into the layers of the skin with a very small hollow needle. If there is no antitoxin in the body of the boy or girl who is being tested, a small red spot appears in a day or two on the arm where the toxin was put in. If, however, the body contains enough antitoxin to protect it from diphtheria, then no

redness appears, because the toxin in the skin has been overpowered by antitoxin. An attack of diphtheria may not, as in the case of measles and scarlet fever, make one immune to future attacks of diphtheria. The Schick Test is of value then in determining who should be made immune and who does not require this.

There is a similar test, known as the Dick Test, which gives us the same information in regard to scarlet fever. If we have enough scarlet fever antitoxin in our bodies, no small red spot will develop when a tiny drop of weakened scarlet fever toxin is placed into the layers of the skin. If we have not enough to protect us from scarlet fever, a small red spot will appear within twenty-four hours.

Suppose that we have not enough scarlet fever or diphtheria antitoxin in our bodies to protect us against these diseases. What can we do? You have already learned that by giving non-poisonous diphtheria toxin we may make our bodies produce antitoxin against diphtheria. One may in somewhat the same way make our bodies produce antitoxin against scarlet fever. In this way, then, we may be protected or made immune against those diseases.

CHAPTER X

OUR LINK WITH THE SEA

Countless ages ago the sea covered much of the land on which we live. We know this to be a fact because great areas of salt are found in certain parts of Canada, such as the salt mines at Windsor, Ontario. It is from these and other salt mines that the table salt which we

use is prepared. The salt, however, which is used for seasoning food is not just like the salt of the sea. In the process of manufacture the crude salt from the mine is purified, and among other things a chemical substance —iodine—is removed.

Within the last few years it has been discovered that man and many animals must have iodine, in order that the body may be strong and healthy and well-formed.

But in order to understand how this discovery was made, it is important for us to know something about a part of our body called the thyroid gland. Man and all animals which have a "backbone" or vertebral column possess a thyroid gland. This, in man, is situated in the neck just below the Adam's apple or larynx. Its shape is not unlike a tiny horseshoe of about two inches in length; its weight is somewhat less than that of a hen's egg. Not very much is known about the action of this gland, but this much we do know, that it helps to control the growth of the mind and the body. In healthy people it has been learned that it also acts somewhat as the carburettor of a motor of a gasoline engine. A carburettor regulates the amount of gasoline and air supplied to the cylinders, and in that way controls the rate of speed of a motor. In our bodies the thyroid gland regulates the speed at which we use up the energy from our food which we have stored. When this important gland in the neck is not supplied with iodine in sufficient quantities, it will not work properly, it becomes enlarged, and we call it a goitre.

It has been known for a long time that people who have goitre live in parts of the world far removed from the sea, and especially in mountainous districts such as

Switzerland and the Himalayas of Asia, the Andes of South America, and the Rockies of North America. The basin of the St. Lawrence River and the Great Lakes is also a region where goitre is frequently found. In these "goitre belts," as they have been called, the amount of iodine in the water and in the food, including salt, is too small to prevent many people from getting goitre.

In those parts of our own country where the amount of iodine in our food and water is least, the number of people with goitre is greatest.

It is very interesting to learn how it was found out that this substance, iodine, when taken into the body in food or in water, is able to prevent goitre. After the Civil War, sheep-raising in Michigan seemed doomed on account of this disease among the flocks. Much money and time were spent in an effort to find a remedy. None was found, but the disease suddenly, as if by magic, disappeared. Only later was the reason discovered. New salt mines were opened up, from which the farmers drew their supply of unrefined or unpurified salt, and it happened that the salt in these new mines contained enough iodine for the health of the sheep. It was just good luck in that case which saved the sheep-raising industry in that district.

The first experiments in which, not luck, but a carefully thought out plan was relied upon, were carried out a few years ago upon brook trout. It was observed that the fish in the hatcheries of a rod-and-gun club developed growths on their necks and were dying in large numbers. As a result of careful study it was found that the trout had goitre. Iodine was added to the water in extremely small quantities, and as a result the fish

became healthy, and the disease disappeared. And as long as iodine was added to the water no goitre was found. Goitre was also prevented, by feeding the trout once a week on chopped sea-fish, which contains a small amount of iodine. In much the same way in Canada goitre has been prevented from developing in pigs, calves, lambs, and colts living in the goitre belt.

You may wonder what all this has to do with the health of boys and girls. Perhaps you can already give an answer. Many children, and adults, too, living in the goitre belt in Canada have not enough iodine in

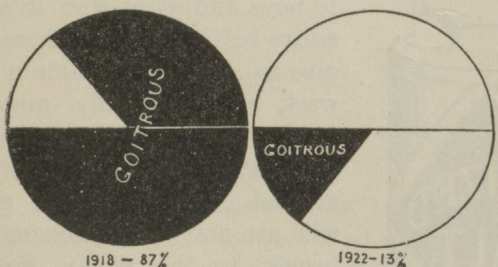

FIG. 72.—How iodine prevented goitre in children in Switzerland.

their food and drinking-water to keep the thyroid gland sufficiently supplied with iodine, and they, too, like the fish and the domestic animals, have goitre. As in the case of the animals just mentioned, so, too, in children goitre may be prevented by supplying iodine in water or food.

The value of prevention in the case of domestic animals may be reckoned in dollars and cents, but the value of the preservation of the health of the body and the mind by the prevention of goitre in children is incalculable. The illustration shows the wonderful results obtained in the prevention of goitre in

Switzerland. In January, 1918, eighty-seven per cent. of school children had goitre; in January, 1922, after iodine had been given for five years, only thirteen per cent were found to have it. In the United States, also, it has been shown how iodine will prevent goitre in school children. Of 2,000 girls in Ohio who were carefully given the proper amount of iodine, only five developed an enlargement of the thyroid gland in the neck, while of the 2,300 who did not take it, 495 showed enlargement.

What is the cheapest and best way to give iodine to boys and girls who live in the goitre belt? One good way is to give to all school children once a week very carefully measured amounts of iodine mixed with chocolate, as was done in Switzerland. But the little children who are not yet at school do not benefit by this plan. For their benefit iodine may be added to the salt used for table use and for cooking. Some companies now supply such "iodized salt," and since every one uses salt, the children at home would also get the proper amount. Sea-fish, which contain small amounts of iodine, when eaten once a week will also help to prevent goitre. Of all diseases it is the easiest one to prevent in boys and girls.

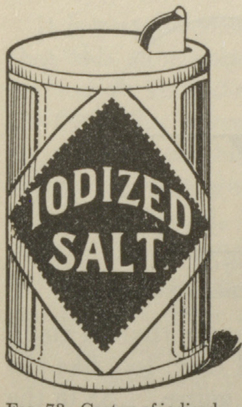

FIG. 73.–Carton of iodized salt.

The total amount of iodine necessary during one year to prevent goitre is very small indeed. The weight of iodine required would be about the same as the weight of sixty granules of white sugar.

The amount of iodine in the body of a full-grown man is about 1–1000 part of an ounce. If you tried to divide a lump of sugar into one thousand parts, you might appreciate what a very, very small amount this would be, and yet we could not be healthy without this minute quantity of chemical substance from the salt water of the sea.

It is only after carefully planned experiments and much diligent work that man has been able to discover that health is sometimes dependent on extremely small quantities of substances, as in the case of vitamins and iodine.

CHAPTER XI.

FIGHTING AN ENEMY WITH FRESH AIR AND SUNSHINE

THERE is a very dangerous and ever-threatening enemy against which we must defend ourselves. This enemy is so strong and does so much harm that every one should know of his wiles and how they may be combated. This enemy is called tuberculosis.

Let us see how powerful this great enemy of mankind is. During the period of the Great War, England, France, and Germany lost greater numbers at home from tuberculosis alone than they lost from shot and shell on the battle-field. The same is true of Canada. In the province of Ontario in 1924, approximately sixteen thousand people were suffering from this disease, and almost one and one-half million dollars was spent for those suffering with tuberculosis, and for their families. Unfortunately, this enemy attacks people at the age when they are of great use to the community, that

is, between fifteen and thirty. But young children and men and women in middle life and in old age are also attacked.

In past years tuberculosis was a much stronger enemy than it is to-day, because people understood so little about his cunning. More than fifty years ago a young physician, Edward Trudeau, became seriously ill with tuberculosis. It was thought that he had but six months to live. He decided to go in quest of health to a hunter's inn situated in the Adirondack Mountains. Here he lived and slept out-of-doors during the cold winter. At that time it was thought that cold weather and even fresh air were harmful to people suffering from tuberculosis. His health improved so much, however, by this treatment, that he was able in time to carry on his medical work among the people living round about.

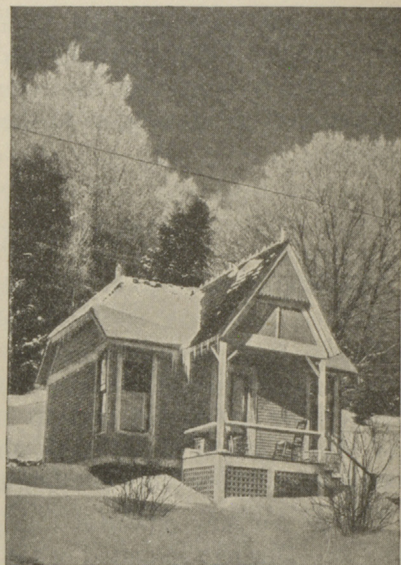

FIG. 74.—The "Little Red" the first cottage sanatorium in America.

Trudeau's great interest in life was to help others who were afflicted with the disease, tuberculosis, to regain their health as he had done. A tiny, one-

roomed frame cottage with porch attached was built for two patients in a hamlet at Saranac Lake. So successful was the open-air treatment of Dr. Trudeau that the good news soon spread. His hopes of helping others back to health began to be realized. Patients came from far and near. This little hamlet at Saranac Lake has become a large town, and in place of one tiny cottage sanatorium there are now many larger ones where hundreds of patients are treated all the year round.

When Dr. Trudeau built his first cottage sanatorium, he did not know what was the cause of tuberculosis. It was not until the year 1882 that the very important discovery was made by Robert Koch, in Germany, that this disease was caused by a germ. The germ he called Bacillus tuberculosis. This great discovery interested Trudeau and other physicians in all parts of the world very much, for without this knowledge little could be known of how tuberculosis was spread from the sick person to those who were well.

After much study it was found out in what ways tuberculosis was spread. We now know that one way is by milk. You will remember that the germs of the disease may get into milk from a cow that has tuberculosis or from a milker who has the disease, if he coughs or sneezes near the milk. Pasteurization of all milk, cream, and dairy products will kill all disease-producing germs. That is one method, then, which will help to prevent the spread of tuberculosis.

A much commoner and more important means of spreading the disease is from person to person. In this regard it is like other communicable diseases such as diphtheria and scarlet fever. Since tuberculosis is spread by those who have the disease, in coughing,

sneezing, spitting, and in other ways of which you have already learned, it is not difficult to understand why tuberculosis often "runs in families." The reason for this is that children of parents who have the disease are apt to get the germs of tuberculosis into their mouths more frequently than other children do.

Since we know the cause of tuberculosis and the ways in which it is spread, why can we not prevent others from getting it by isolating all people who have the disease and quarantining those who have been exposed to it? Before we answer this question, let us see in what ways tuberculosis differs from other communicable diseases, scarlet fever, for example. Scarlet fever is a quick disease, and for that reason is called "acute." Tuberculosis is generally a slow or "chronic" disease. Indeed, it may be some years after the germs of tuberculosis enter our bodies and grow there before we become ill. It may also take years before we regain health. Another difference is that it is very much more difficult to recognize tuberculosis early than it is in the case of many other communicable diseases. Indeed it is only by the most careful examination by specially trained physicians that tuberculosis may be detected early. Hence, since it is a slow disease which is often difficult to recognize, and since so many people have it, it is not possible to isolate every case or quarantine those who have been exposed.

In spite of the fact that the cause is known, and in spite of years and years of careful work carried on in many lands, there has not been discovered any magic cure for tuberculosis like antitoxin for diphtheria. Nor have we yet learned a way to build strong forts

within our bodies to defend us against it, as we have against smallpox, typhoid fever, diphtheria, and other diseases. A great deal, however, is now known, and by applying this knowledge very much can be done for the prevention and the treatment of tuberculosis.

Out of Trudeau's great desire to help others regain their health as he had done, the sanatorium treatment for tuberculosis developed in America. The little cottage in the Adirondacks was the first step. To-day there are many sanatoria throughout Canada where

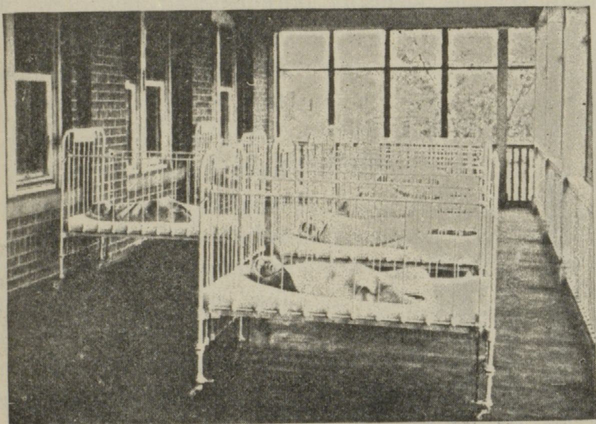

FIG. 75.—Children sleeping on open-air verandah at the preventorium, Toronto.

people with tuberculosis may rest and live in the open air and sunshine. Here patients not only regain their health, but are carefully taught how they may prevent the germs of the disease from spreading to others. Indeed, if all sufferers from tuberculosis could be taught these lessons, and if they carried out the instructions in regard to coughing, spitting, and kissing, and the rules they should follow, there would soon be but few

people ill with this disease. The careful instruction of those who have tuberculosis is, then, a most important means for the prevention of the spread of this disease.

The battle against this great enemy is being waged in other ways. Children who have been exposed to tuberculosis in their homes are cared for in preventoria. Here they live in the open air, take plenty of rest, and are given good food. In a few months many of these delicate children are made strong and healthy, and the danger of tuberculosis developing is past. Open-air schools, sleeping porches, and bedrooms with wide-open windows all help in the great crusade against this powerful enemy.

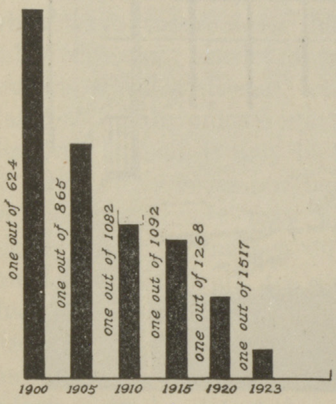

Fig. 76.—Retreat of the great enemy. Deaths from tuberculosis in Ontario since 1900. In 1900 one out of every 624 persons died of tuberculosis; in 1923, one out of 1517.

Let us see how far we have made the enemy retreat. The deaths from tuberculosis in Ontario have been steadily decreasing, until in 1924 there were fewer by half than there were twenty years before. What are the reasons for this? We have already mentioned some of them—pasteurization of milk, sanatoria, preventoria, and open-air schools. Other reasons are: better houses with more light and fresh air, fewer crowded districts in our cities and towns, better working conditions in our factories, and medical inspection in our schools. Money is also being spent wisely, to check the enemy. Great advances have been made in the means

of recognizing the disease early. This is very important indeed, because the sooner a patient is instructed in the rules he must follow to prevent the spreading of the disease to others, the fewer people will contract it from him. In addition, the earlier tuberculosis is discovered, the better is the chance of recovery. Indeed we now know that if proper treatment is begun early, health may be regained in the great majority of cases.

Sufficient rest and exercise, good food, fresh air and sunshine—these are useful weapons against the insidious enemy, tuberculosis.

The teacher will find the following brief list of books and pamphlets interesting and useful.

How to Live. Fisher and Fiske. Funk and Wagnalls...... $1 75
First Aid to the Injured. St. John's Ambulance Association 0 60
Alcohol—Its Action on the Human Organism. Report of the British Medical Research Council..................... 1s. 0d.
The Science of Ventilation. Report of the British Medical Research Council................................ 1s. 0d.
Hygiene of Food and Drink. Board of Education, England. 2s. 0d.
Morphinism. Issued by the Federal Department of Health, Ottawa.. Free
How to Build Sound Teeth, Etc. The Federal Department of Health, Ottawa................................ Free
Rural Sanitation, Etc. Issued by the Provincial Department of Health.................................... Free
Child Welfare, Etc. Issued by the Provincial Department of Health...................................... Free
What You Should Know About Tuberculosis. Issued by the Canadian Tuberculosis Association, Ottawa............. Free
Social Hygiene Literature. Issued by Social Hygiene Council, Elm Street, Toronto.............................. Free
Health Literature. Issued by The Canadian Red Cross Society, Sherbourne Street, Toronto...................... Free
A Way of Life. William Osler......................... $0 50

III. ACCIDENTS AND EMERGENCIES

CHAPTER I

SAFETY FIRST

ACCIDENTS are often avoidable. Many cuts, bruises, sprains, broken bones, burns, and other painful injuries might have been prevented by a little care. It is commonly said that "it takes two to make a quarrel," and so it might almost as truthfully be said that "it takes two to make an accident." We generally blame the careless motorist when somebody is run over. We blame the person who carelessly leaves some broken glass or a loose plank in the wrong place, when we are cut by the one or injured by falling over the other, yet the injured one is often himself to blame as much as is the other.

Carelessness accounts for the greatest number of accidents. For example, before crossing a street made dangerous by motor traffic, some boy fails to look both ways to see if the road is clear before stepping off the curb. Just as he does so he is struck by a passing car. A little care on his part would have prevented this.

Bravado is responsible for many accidents among schoolboys. A boy is often "stumped," as they say, to go out on the ice before the river is properly frozen over, and because he is afraid to "take a dare" he attempts it. With a show of bravery he starts out boldly, but before he reaches the other side the ice cracks, and gives way, and he breaks through the gap into the cold water. He makes a few futile efforts to cling to the edge of the ice, which is too thin to support him, and before the other boys can push out a pole to which

he might cling, he sinks and is drowned. Another is dared to climb up some unsafe and shaky structure which cannot support his weight, and not having the courage to refuse, he starts to climb. Then as he nears the top something to which he clings gives way, and he falls to the ground and breaks his arm.

Playing tricks on others is also the cause of many injuries. One boy pulls a chair from under another just as he is about to sit down. This is generally done for a bit of fun, but it often results in serious injuries to the back or to the head of the victim. Tripping somebody who is not looking is another dangerous trick to play.

These are but a few examples showing how carelessness, bravado, or foolish tricks may lead to serious accidents. It is far better to practise the well-known motto "Safety First," and so avoid many needless accidents to ourselves as well as to others.

Ignorance also accounts for many accidents. For example, since the motor car has come into general use, accidents due to the breathing of motor fumes in a closed garage are becoming increasingly numerous. The poisonous gas is called carbon monoxide and is produced, not only by gasoline motors, but by furnaces and stoves when the draught is not good. It is also contained in the gas used for cooking and lighting. Carbon monoxide is colourless, tasteless, and almost odourless, so that its detection by the senses is almost impossible. It is a very poisonous gas. One part of it mixed with one thousand parts of air is enough to become dangerous when breathed, and it has been found that a gasoline motor will in three minutes produce enough carbon monoxide to make the air dangerous to breathe in a

garage 10 x 10 x 20 feet *if the doors and windows are shut.* So one must remember never to run a motor in a closed place.

It is also important to remember that furnace fumes, leaky gas connections, and charcoal fires with poor draughts are always dangerous, and even though the amount of carbon monoxide is not always sufficient to make one unconscious, it may, if breathed for a long period of time, cause ill health.

Whether the accident, however, is due to one's own fault or not, the injury resulting from it should be attended to at once, and everything possible should be done to make the patient comfortable. Boys and girls should not attempt to take the place of doctors and nurses, and it is not expected that they should understand the treatment of injuries, but there are a few things which they can often do to ease the pain, stop the bleeding, and prevent infection or blood-poisoning. They can in these ways be of great service in giving first aid, and so make the patient more comfortable until some older person or the doctor arrives.

The books upon emergencies usually contain lists of supplies which are needed for emergencies. These are tincture of iodine for applying to wounds to prevent infection, gauze to use as dressings or coverings for the wound, and adhesive plaster to retain these dressings in place. Bandages are used for the same purpose and for sprains and other injuries. It is not to be expected, however, that boys and girls should have any of these things with them when accidents occur.

Fortunately, however, the most useful things a person can have in an emergency are a pair of steady hands and a cool head to guide them. With these one need

never be alarmed by the lack of supplies. The following information will be confined to those simple but useful things which a boy or a girl should be able to do in an emergency, when other help is not at hand.

NOTE:—

Every class room should be supplied with a simple emergency kit. This should contain:

1. Pair of scissors
2. A pair of forceps
3. A roll of two-inch wide adhesive plaster
4. A few gauze bandages two and a half inches wide
5. A package of absorbent cotton
6. Half a dozen aseptic gauze pads
7. A small bottle of tincture of iodine
8. A tube of boracic vaseline

This simple kit will cost but little and will prove of great service.

CHAPTER II

ARTIFICIAL RESPIRATION

ARTIFICIAL respiration is used to revive those apparently drowned and those overcome by gas, or electric shock. The method devised by Professor Schäfer of Edinburgh is so simple that a boy or a girl can easily learn to use it. As nothing but a cool head and a steady pair of hands are required, we should learn the method and practise it occasionally, so that when an emergency arises we may be able to meet it.

In cases of drowning it often appears as if the victim, when taken from the water, were actually dead. Just because he does not breathe or because we cannot hear his heart beat is no reason why we should not make every effort to revive him. First send for a doctor.

Schäfer's method of artificial respiration:

"Immediately on removal from the water, place the patient face downwards on the ground with a folded coat under the lower part of the chest. Not a moment

must be wasted by removing the clothing. If respiration has ceased, artificial respiration is to be commenced at once; every instant of delay is serious.

"To effect artificial respiration, put yourself astride or on one side of the patient's body in a kneeling posture and facing his head (see Figure). Place your hands flat over the lower part of the back (on the lowest ribs) one on each side, and gradually throw the weight of your body forward on them, so as to produce firm pressure —which must not be violent—upon the patient's chest. By this means the air (and water, if there is any) is driven out of the patient's lungs. Immediately there-

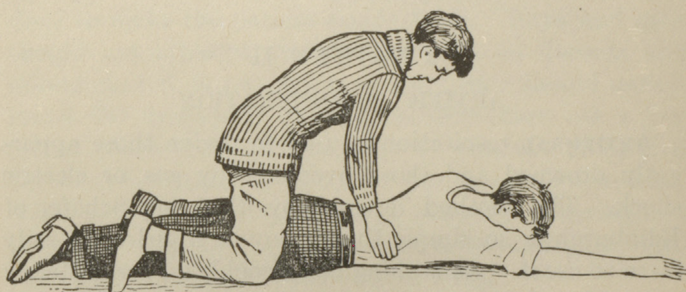

Fig. 77.—Position for applying artificial respiration.

after raise your body slowly, so as to remove the pressure, but leave your hands in position. Repeat this forward and backward movement (pressure and relaxation of pressure) every four or five seconds. In other words, sway your body forwards and backwards upon your arms twelve or fifteen times a minute, without any marked pause between the movements. This course must be pursued for at least half an hour, or until the natural respirations are resumed. If they are resumed, and as sometimes happens, again tend to fail, the process of artificial respiration must be resorted to again as before.

"Whilst one person is carrying out artificial respiration in this way, others may, if there be opportunity, busy themselves with applying hot flannels to the body and limbs and hot-water bottles to the feet; but no attempt should be made to remove the wet clothing or to give any restoratives by the mouth until natural breathing has recommenced."

As cases are on record of recovery after two and three hours' work, you should keep on for an hour or more. Do not spend time looking for a coat to place under the body, as this is the least necessary part of the procedure.

After treatment:

When the patient begins to breathe naturally, he should be kept lying down. He may be moved on a stretcher, however, to a more sheltered spot or to a warm bed with a free circulation of air about it. Until the arrival of a doctor, stimulants such as hot coffee or tea may be given, care being taken that the patient is not allowed to choke or strangle in attempting to swallow.

Summary:

1. Place the patient face downward with his arms extended forward and above his head.

2. Kneel astride the patient's body just below his hips. Place your hands flat over the lower part of the back, one on each side.

3. Press down on the ribs while counting slowly "One and Two and Three," or for about four or five seconds.

4. Then swing back, releasing the pressure while counting slowly "One and Two and Three."

Repeat these motions until the patient revives.

CHAPTER III

FIRST AID

Cuts and Wounds:

1. Stop the bleeding.
2. Keep the wound clean.
3. Put the part at rest.

You may stop the bleeding by applying pressure on the wound with a clean piece of gauze or linen. A handkerchief would do if it had just been boiled previously to make it clean, but as it takes too much time in emergencies to boil it, wash it out with soap and water, if possible, before using it. If the bleeding is but slight, it is better to leave it alone. It will soon stop of itself. If on the other hand, the blood comes out in spurts, an artery has probably been cut; pressure should then be applied immediately.

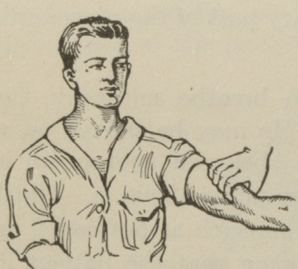

FIG. 78.—Applying pressure to the large artery of arm to stop bleeding.

If the cut is on the hand or forearm, pressure by the fingers over the brachial artery, the large artery of the arm, will stop the bleeding.

FIG. 79.—The large artery of arm.

This pressure is difficult to maintain for any length of time, and the best and quickest way to apply pressure is to take a scarf, large handkerchief, cloth-belt, or braces, and tie any one of these in a loose loop around the limb above the wound. Then insert a stick in the loop and twist it so that it compresses, or squeezes the arm suffi-

ciently to stop the bleeding. This is called a tourniquet. It is best to tie a knot in the cloth or braces before placing it around the arm, and this knot should be placed directly over the artery if possible. This causes direct pressure on the artery, and so more readily stops the bleed-

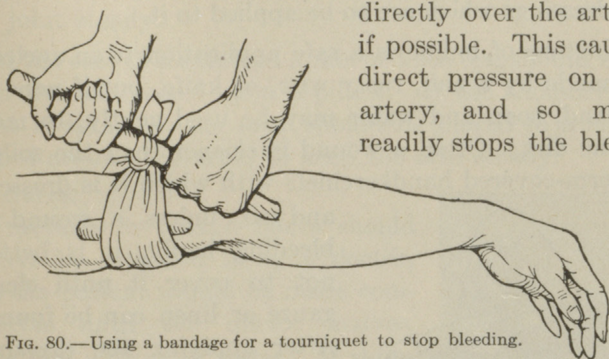

Fig. 80.—Using a bandage for a tourniquet to stop bleeding.

ing. If the cut is on the foot or the leg, pressure on the femoral artery, which is the large artery of the leg, may be made with the hand, until some one prepares a tourniquet which may be applied to the leg in the same manner as described for the arm.

Fig. 81.—The large artery of leg.

Pressure may also be applied by placing a pad made from a large folded handkerchief or cloth in the back of the knee. Then bend back the leg at the knee, and this presses on the artery.

If a vein is cut, the blood will be darker in colour than the lighter coloured blood from an artery. It would need pressure over the wound, below it, or on the side away from the heart, to stop the bleeding.

In any case keep control of the bleeding by pressure, until the doctor arrives.

Cleanliness is very important in handling wounds and cuts, and it is always best to wash the hands with soap and hot water before attending the wound or touching the dressings which are to be applied to it.

Tincture of iodine is a safe application to an unclean cut made by a nail, rusty wire, or knife, but if none is at hand, soap and water may be used gently, to mop off the dirt. Often a wound is cleaner than the soiled or germ-covered handkerchiefs with which it is dressed, and so, unless a wound is bleeding badly, it is better not to cover it until clean gauze or linen can be found. After applying the dressing of gauze or linen, bandage it to keep the gauze in place. The bandage may be made from a handkerchief, scarf, or tie.

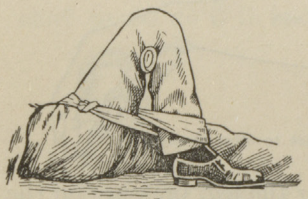

Fig. 82.—Pad used for pressure to stop bleeding below the knee.

If the wound is on the hand or arm, the arm may be placed in a sling made by tying a scarf over the shoulder. This keeps the part at rest.

If the cut is on the leg, the patient should remain lying down, with the foot raised upon a pillow.

Sprains:

These are due to the tearing of the ligaments of the ankle, knee, shoulder, wrist, and other joints. Strains are less serious, but quite painful. For both sprains and strains apply cold compresses, which may be made of handkerchiefs or towels wrung out of cold water.

Some advise the application of hot water to the painful joint. The effect of hot and cold applications is practically the same, but as cold water is more readily ob-

tainable, and never accidentally causes scalding, it is to be preferred. In either case have the injured part at rest, and comfortably bandaged, if possible, to keep the joint steady.

In the case of a sprained ankle or knee one should rest with the foot raised upon a pillow. If the shoulder or wrist is sprained, the arm should be placed in a sling looped around the neck, to keep the arm steady.

Fractures:

Fig. 83.—A sling for an injured hand or arm.

Fractures or broken bones should always be attended to by a doctor, but the patient should be made comfortable until the doctor arrives. Give him a drink of water. If it is a cold day see that he is warm, if the weather is warm see that he is kept cool and as comfortable as possible. In fractures the broken leg or arm is generally crooked or out of shape as compared with the other arm or leg. If you are far away and alone with the patient, see that he is lying down with arm or leg at rest. Do not move him, or you may make the fracture worse. If a splint is to be applied, you may take a flat stick long enough to pass

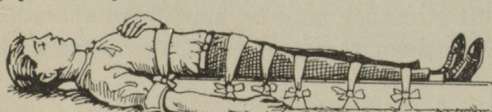

Fig. 84.—Emergency splint for leg broken above the knee.

below the joint which is below the fracture and above the joint which is above it, so that, in moving the limb, there may be no chance of the fractured ends of the

bone piercing the flesh of the limb. The splints may be padded with moss, or handkerchiefs, towels, or scarfs, etc., and tied comfortably around the limb, above and below the fracture. Bind an arm, broken above the elbow, to the side of the body; but a broken hand or forearm must be placed in a sling. A broken leg should be bound to the other leg, so as to keep it steady.

Stretcher:—

It may be necessary to carry the patient home on a stretcher, and this may be made from a plank, a shutter, a bench, or a ladder. A blanket and two poles can

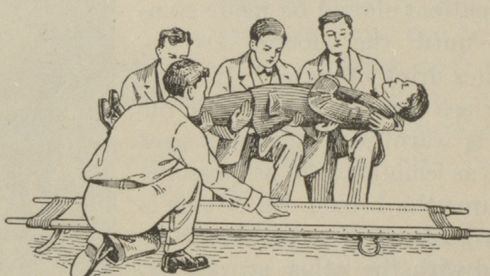

Fig. 85.—Lifting an injured person on to a stretcher.

be made into a good stretcher. Roll one side of the blanket around one of the poles three or four times. Then roll the opposite side of the blanket around the other pole placed parallel with the first one in the same way. This stretcher may be kept from spreading by a cord tied between the handles at the front and at the back.

Another form of stretcher may be made by cutting a hole in both the lower corners of a grain bag, then passing two poles through the bag and through the holes in a parallel position. This will give but a short body to the stretcher, but it may be doubled in length

by taking another bag and doing the same thing with it, placing one bag behind the other on the poles.

In lifting the patient to the stretcher, care should be taken not to bend the fracture or hurt the patient. If three boys are at hand, they should all get on one side of the patient, each kneeling on the right knee. Then one of the boys, with his hands under the head and shoulder of the patient, another with his hands under the hips, and the third with his hands under the feet, should all lift together, gently raising the patient on their left knees and from there to the stretcher. A fourth boy, on the other side, should steady the patient and look after the stretcher.

Removal of Clothing:—

Clothing should not be removed unless necessary, but if there is much bleeding, or if you have to get at the injury, remove the coat from the sound side first, and if necessary slit up the seam of the sleeve on the injured side, so that you will not make the injury worse by rough handling. The same may be done with the shirt. The trouser leg should be slit on the outer seam. The laces should be cut or undone all the way down, before trying to remove the boots, and the socks may be cut.

Dog Bite:

If you have no tincture of iodine to apply to the wound, clean it thoroughly with soap and warm water, and send for the doctor.

Frost Bite:

In case of frozen ears, nose, fingers, or toes, rub the parts, which are generally white and numb, with snow or cold water. Do this outdoors or in a cold room. Continue to rub until a tingling is felt in the frozen part.

Foreign Bodies:

1. *A foreign body in the throat*, such as a fish-bone, a piece of meat, or a bread crust "going down the wrong way" will cause choking. Instead of going down the gullet, which is the proper channel for food to enter the stomach, it gets into the opening above the windpipe, and so cuts off the supply of air to the lungs. This causes the person to gasp and choke. He coughs, gets red in the face, and struggles for air. To give relief, hold his head down and give him a smart slap on the back. This will generally dislodge the morsel of food, and he will be relieved. A drink of water will frequently be sufficient. Sometimes it may be necessary to insert the finger into the mouth and remove the foreign body.

2. *A foreign body in the eye*, such as a speck of dust or cinder, causes the eye to water and smart. Do not rub the eye.

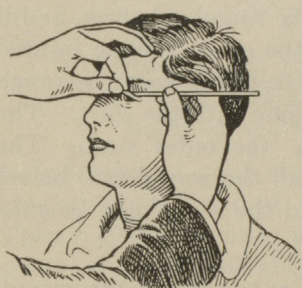

Fig. 86.—Turning over the upper eyelid to remove a speck which has lodged there.

If the speck is lodged under the lower lid, pull this gently forward, and remove the speck by brushing it off with the corner of a handkerchief. If it is lodged under the upper eyelid, gently lift the upper lid forward over the lower lid and let go. As this is done, the lower lid may brush off the speck as it returns to its place.

If no doctor can be had and the speck is still painful but cannot be seen, turn the upper lid over the handle of a penholder or a pencil by taking hold of it

at the eyelashes, and pulling it up gently. This turns the lid inside out, exposing the speck, which is generally lodged there. The speck may then be removed by brushing it off with the folded corner of a handkerchief. If, however, it is lodged on the eyeball or stuck fast under the upper lid, leave it alone. Cover the eye lightly with a pocket handkerchief and have a doctor attend to it.

In case an acid or lime gets into the eye, flush out the eye with water while waiting for the doctor. Pour the water between the lids so that the smarting acid or alkali will become diluted and so do less harm and cause less pain.

3. A foreign body in the nose, such as a shoe button, a bean, or a pea may be removed by blowing the nose rather vigorously. If that does not remove it, wait until you get home and have your parents or the doctor attend to it.

4. A foreign body in the ear should be left for the doctor to remove. It is dangerous to tamper with anything in the ear. If an insect should get into it, a little water or olive-oil poured in will generally suffice. Never use anything to pick wax from the ear.

Clothing on fire:

If a person's clothing should catch fire, smother the flames with a rug, overcoat, or blanket, while the victim is lying on the floor.

If a person whose clothing is afire runs about, it will increase the draft and make the flames worse. Water should be thrown on the burning clothes.

If you ever read Charles Dickens' fine story, *Great Expectations*, you will see how the peculiar old lady in the book, whose clothing caught fire, was saved by the

hero, Pip, who wrapped his heavy overcoat around her and kept her on the floor until the flames were smothered.

Burns and scalds:

These should be covered to keep out the air. Clean cloths dipped in water to which baking-soda has been added may first be applied. Then apply vaseline, lard, or cream in which soda has been mixed, or olive-oil and lime-water.

If the burns are deep or if they cover a large surface, the doctor should be sent for.

Poisons:

If a person has swallowed a strong alkali, such as lye or ammonia, he should take something quite opposite to act as an antidote, for example vinegar or lemonade, which are both acids.

If he has swallowed a strong acid, he should take for an antidote a mild alkali, such as baking soda in water.

In both cases, as the acids and alkalies burn the lips, mouth, and gullet, something soothing should be given, after taking the antidote, and the best things to give are the raw whites of eggs, cream, or olive-oil.

In all other cases of poisoning where the lips are not burned, give an emetic to make the patient throw off the poison. An emetic may be made by mixing a teaspoonful or more of mustard in a tumblerful of warm water or a tablespoonful of salt in a tumbler of warm water.

Either of these is to be followed by plenty of warm water to drink. In all cases of poisoning send at once for the doctor.

Unconsciousness:

This may occur as the result of fainting, fits, concussion, or stunning from a blow on the head or from a fall. It occurs, too, in cases of drowning, gas poisoning, electric shock, and strangulation.

First Aid for Unconsciousness:

Fainting:—

When a person suddenly falls over unconscious and his face looks very white, he has probably fainted. This may be due to the stuffy air in the room, to an injury, a shock, or even to the sight of blood. In trying to restore the patient, there are three important things to remember:

1. Head low
2. Fresh air
3. Water.

1. Head Low.—The first thing to do is to lower the patient's head. Place him on a bench or sofa or upon the floor, with no pillow under his head. This alone will generally revive him. Sometimes it is best to raise the foot of the bench or sofa upon which he is lying, or raise his feet slightly if he is lying upon the floor, so that his head is made lower than his feet. This causes the blood to flow more freely to the brain.

2. Fresh Air.—Get the patient out of doors into the fresh air, or open the windows so that the fresh air may reach him. Fanning the patient improves the circulation of the air, and so freshens it and helps to revive him.

3. Cold Water.—Bathe the forehead with cold water. A drink of water may be given as soon as the patient revives sufficiently to swallow.

Any tight clothing, such as collars and belts, should be loosened.

Sometimes one may feel faint and dizzy when sitting in a crowded and stuffy room. By bending forward with the head low, this feeling may often be overcome, and fainting prevented.

Fits:—

Some people are subject to fits, and when they have them they fall unconscious, roll their eyes, and they may also foam at the mouth. Their faces are not white as in fainting, but become red or almost purple in colour. Fortunately, these distressing fits are rarely dangerous. The greatest danger at the time is that the patient may injure himself by falling against some hard furniture or burn himself against a hot stove. In such cases just remove him away from this danger and keep him from thus injuring himself.

Concussion:—

This occurs when a person is stunned from a fall. There may be a cut in the head which, if it is bleeding, should be attended to first. Raise the head on a pillow and apply cold water to the forehead by wringing out a handkerchief from cold water. Loosen the patient's collar. If it is a cold day, cover him with a coat or blanket. Keep him quiet and send for the doctor.

Drowning:—

One should start artificial respiration at once where the patient has been brought ashore.

Electric shock:—

In cases of electric shock we should at once release the victim from the current, being very careful to avoid

receiving a shock ourselves. To remove him from the wire we should use some non-conductor, such as a dry stick, or a piece of rope, or we may take hold of his clothing, being very careful not to touch his hands, face, or body in pulling him away. It is also best to stand on a dry piece of cloth, such as a coat or a piece of board, or newspaper to avoid shocks. Rubbers also are useful. As soon as the victim is free from the wire, start artificial respiration.

Gas poisoning:—

In cases of gas poisoning we should remove the victim at once into the fresh air, or if that is not possible, open wide the windows and doors, and then start artificial respiration immediately.

Summary of First Aid treatment for cases of unconsciousness

Fainting	1. Head low 2. Fresh air 3. Water	
Fits	1 Keep patient from injuring himself 2. Loosen collar	
Concussion	1. Raise head 2. Fresh air 3. Water 4. Dress wound 5. Quiet	Send for the doctor at once in all of these cases
Drowning	Artificial respiration	
Electric shock	1. Remove from "live wire" 2. Artificial respiration	
Gas poisoning	1. Fresh air 2. Artificial respiration	
Strangulation	1. Loosen the collar 2. Artificial respiration	

APPENDIX

I. TABLES OF HEIGHTS AND WEIGHTS

A KNOWLEDGE of our height and weight is important, for from this we can measure our growth. Just as plants and animals grow when they are healthy, so boys and girls should grow. A boy can get a very good idea regarding his growth, by comparing his height and weight with the general averages taken from the examination of a large number of other boys and girls.

In comparing them, however, it is well to remember that one's height and weight depend partly upon the size of his parents, and that a boy would be considered to be of proper size if his height and weight followed closely those of his parents. The son of small parents could not expect to be as large as the son of large parents, although he may, occasionally, be larger.

FIG. 87.—Finding his weight.

The following tables of heights and weights were prepared by the Department of Health of the city of Toronto, and were taken from the findings of 59,291 school children.

The first vertical column gives the height in inches. The top horizontal line gives the ages, and the figures in the vertical columns below these give the average weights. Find your height in the left-hand column of

the table, and what you ought to weigh will be found on the same line in the column under your age. For example, the average weight of a boy 62 inches in height and 13 years of age would be 101 pounds.

Weight in Pounds for Boys

Height in Inches	Age in Years											
	5	6	7	8	9	10	11	12	13	14	15	16
39	36	..	..	..	..	..	..	..	..	..	..	..
40	38	38	..	..	..	..	..	..	..	..	..	..
41	38	39	..	..	..	..	..	..	..	..	..	..
42	39	40	41	..	..	..	..	..	..	..	..	..
43	41	42	43	44	..	..	..	..	..	..	..	..
44	42	44	44	45	..	..	..	..	..	..	..	..
45	44	46	46	47	49	..	..	..	..	..	..	..
46	46	48	48	48	50	..	..	..	..	..	..	..
47	..	50	50	51	51	52	..	..	..	..	..	..
48	..	52	52	53	54	54	55	..	..	..	..	..
49	..	..	55	55	56	56	58	..	..	..	..	..
50	..	..	57	57	58	59	60	62	..	..	..	..
51	..	..	59	60	61	62	63	64	66	..	..	..
52	..	..	..	63	63	64	65	66	67	..	..	..
53	..	..	..	65	66	67	68	69	70	72	..	..
54	..	..	..	..	69	70	71	72	73	74	..	..
55	..	..	..	..	71	73	74	75	76	77	80	..
56	..	..	..	..	..	76	77	77	78	79	81	..
57	..	..	..	..	..	79	80	81	82	83	84	..
58	..	..	..	..	..	..	83	84	85	86	87	88
59	..	..	..	..	..	..	87	88	89	90	92	93
60	..	..	..	..	..	..	..	93	94	95	96	97
61	..	..	..	..	..	..	..	95	98	99	100	102
62	..	..	..	..	..	..	..	99	101	103	104	105
63	..	..	..	..	..	..	..	..	106	108	109	110
64	..	..	..	..	..	..	..	..	113	114	115	116
65	..	..	..	..	..	..	..	..	..	118	120	121
66	..	..	..	..	..	..	..	..	..	121	125	126
67	..	..	..	..	..	..	..	..	..	127	129	130
68	..	..	..	..	..	..	..	..	..	..	134	135
69	..	..	..	..	..	..	..	..	..	..	137	138
70	..	..	..	..	..	..	..	..	..	..	142	143

While under normal conditions of health the average boy of this height and age should weigh 101 pounds, he need not worry if he weighs within about ten per cent

above or about ten per cent below this figure. That is to say, his weight would be considered to be within natural limits if he weighed between 91 and 111 pounds. If his weight were less than 91 pounds, however, he

Weight in Pounds for Girls												
Height in Inches	Age in Years											
	5	6	7	8	9	10	11	12	13	14	15	16
39	34	..	..	..	..	..	..	..	..	..	..	..
40	35	37	..	..	..	..	..	..	..	..	..	..
41	37	38	39	..	..	..	..	..	..	..	..	..
42	39	40	40	..	..	..	..	..	..	..	..	..
43	41	42	42	42	..	..	..	..	..	..	..	..
44	42	44	44	44	..	..	..	..	..	..	..	..
45	44	46	46	46	47	..	..	..	..	..	..	..
46	46	47	47	48	48	49	..	..	..	..	..	..
47	..	49	49	50	50	51	..	..	..	..	..	..
48	..	51	52	52	52	53	54	..	..	..	..	..
49	..	54	54	54	55	55	56	..	..	..	..	..
50	..	..	57	57	57	58	59	60	..	..	..	..
51	..	..	58	59	59	60	61	62	..	..	..	..
52	..	..	..	62	62	63	64	65	66	..	..	..
53	..	..	..	64	66	67	67	68	71	..	..	..
54	..	..	..	66	69	69	70	71	72	75	..	..
55	..	..	..	..	73	73	73	74	75	78	..	..
56	..	..	..	..	75	76	77	77	79	79	..	..
57	..	..	..	..	..	78	80	80	83	85	88	..
58	..	..	..	..	..	81	84	85	86	90	91	95
59	..	..	..	..	..	..	89	90	92	94	97	100
60	..	..	..	..	..	..	91	93	96	98	101	102
61	..	..	..	..	..	..	..	95	100	102	106	107
62	..	..	..	..	..	..	..	101	102	106	108	110
63	..	..	..	..	..	..	..	..	108	110	112	114
64	..	..	..	..	..	..	..	..	112	114	118	119
65	..	..	..	..	..	..	..	..	..	118	120	123
66	..	..	..	..	..	..	..	..	..	122	123	126
67	..	..	..	..	..	..	..	..	..	..	126	128
68	..	..	..	..	..	..	..	..	..	..	130	132

would be underweight, and if he weighed more than 111 pounds he would be overweight. It would then be wise to call his doctor's attention to his weight, and perhaps the doctor would suggest a little more rest and a fuller diet with more milk to drink, if the boy were too thin,

and a little more exercise and less sugar, potatoes, and white bread in his diet, if he were too fat.

Measurements should be taken in school clothes but without coat and shoes. The table for girls, which is to be used in the same way, is shown on page 198.

II. DIET TABLES

THE following makes a good, average day's diet for an active, healthy boy of twelve or thirteen years of age. The estimated food values are expressed in calories. These are more or less approximate, as it is very difficult to estimate the exact quantities, and sometimes impossible to estimate the quality of the food.

DIET FOR A BOY

Breakfast	*Quantity*	*Calories*	
Apple	1 medium size	75	
Oatmeal porridge	6 tablespoonsful	85	
Sugar	1 dessertspoonful	60	
Milk	half glass (4 oz.)	80	
Egg	1 large size	75	
Bread (whole wheat)	(4 x 4 x ½ inch) 2 slices	140	
Butter	about a cubic inch	80	
Milk	1 glass (8 oz.)	160	
		——	755
Dinner	*Quantity*	*Calories*	
Meat (or Fish)	2 ounces	98	
Potatoes	2 tablespoonsful	80	
Fresh vegetables	3 tablespoonsful	100	
Bread and butter	1 slice	110	
Rice pudding	3 tablespoonsful	250	
Milk	1 glass	160	
		——	798
Supper	*Quantity*	*Calories*	
Shredded wheat	1 biscuit	110	
Milk and sugar	same as before	140	
Muffins (whole wheat)	2 (2 oz. each)	250	
Maple syrup	2 tablespoons	135	
Milk	1 glass	160	
		——	795
Total number of calories for the day			2,348

A girl requires somewhat less than a boy of the same age. The following table shows how variety may be added to one's diet. Both of these tables give diets which contain all the required proteins, fats, carbohydrates, mineral salts, and vitamins.

DIET FOR A GIRL

Breakfast	*Quantity*	*Calories*	
Orange	1 medium size	75	
Shredded wheat	1 biscuit	110	
Sugar and milk	same as before	140	
Toast and butter	2 slices	220	
Cocoa	1 cup, ¾ milk	148	
Sugar	2 lumps	60	
			753
Dinner	*Quantity*	*Calories*	
Poached egg	One	75	
Potato, baked	One ($3\frac{1}{3}$ oz.)	100	
Tomato	One	30	
Bread and butter	1 slice	110	
Peaches (preserved)	5 ounces	75	
Milk	1 glass	160	
			550
Supper	*Quantity*	*Calories*	
Tomato soup made with milk	4 ounces	150	
Bread and butter	2 slices	220	
Baked apple	1 medium size	100	
Plain cake	2 ounces	200	
Milk	1 glass	160	
			830
Total number of calories for the day			2,133

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